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AT

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BY

WILLIAM HENRY COLE, M.Inst.C.E.
(LATE DEPUTY MANAGER, NORTH-WESTERN RAILWAY, INDIA.)

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PREFACE.

Light Railways postulate greater facilities for promotion, cheaper construction, simpler working, and more lenient conditions generally than are applied to ordinary or standard railways; but, as pointed out in Chapter I., light and standard railways only differ from each other in degree, and no sharp line can be drawn between them. We are all feeling our way in the matter of light railways, and the treatment of a subject which is more or less unformed and undefined presents peculiar difficulties. The late Mr Corrie L. Thompson's *Catalogue of Books, Reports, Papers, and Articles relating to Light Railways*, 1895, was a most useful guide to a literature which is necessarily scattered and incomplete. To sift this information, and to collect and arrange useful matter in a convenient and readable form was the result I aimed at.

In Chapter II. I have tried to give the general reader some idea of the principles which govern the classification of goods and the application of rates. Passenger fares may vary directly as the mileage, but not, as a rule, goods rates. Of all the factors which affect the cost of goods service, distance is often the least important. It will usually pay a railway better to carry properly packed foreign produce right through from port to market than small home consignments picked up at intermediate stations. Not only, however, is it generally impracticable to lower local rates to the level of import rates, but attempts to satisfy the home producer by raising the import rates have sometimes merely resulted in forcing the foreign produce to find a cheaper way to the market by sea. The British agriculturist's ultimate remedy lies, not in requiring the railways to "boycott" the foreigner, but in adopting better methods of packing, in combining to make up larger consignments, and in the development of light railways under the Act of 1896. Why—as Mr W. M. Acworth once asked—if light railways are useful to foreign farmers, must they be useless to English farmers? In the writing of this

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chapter I am indebted to Acworth's *The Railways and the Traders*, to Grierson's *Railway Rates*, to Hadley's *Railroad Transportation*, and to a course of three lectures on *Railway Management* (Calcutta, Bengal Secretariat Press, 1896) delivered at the Sibpur Engineering College by S. Finney, Manager (under whom I held the post of Deputy Manager) of the Eastern Bengal State Railway.

What other European countries have done towards the development of light railways has been briefly described in Chapters III.–VI. No system, in regard to its organization and results, offers to those interested in light railways so instructive a field for study as that of Belgian Light Railways. They owe their development to the foundation in 1885—*with the express object of enabling agriculturists to compete with foreign producers*—of the National Society of Local Railways, which holds the monopoly of light railway concessions, determines the contributions of the State, provinces, communes, and private individuals (a small proportion), and distributes the profits. Under the Act of 1896 we have, at last, secured equal facilities and as simplified a procedure; but, as our Light Railway Commissioners simply deal with applications made to them for an order authorizing a light railway, State aid is practically unknown, financial assistance from local authorities is seldom sought, and private enterprise is still the mainspring. A close parallel has been traced in some detail between the cost of Belgian Light Railways and light lines on the same (metre) gauge in India. In France the direct control of the light railways is placed in the hands of the Prefects, and the tendency is for the departments to construct the lines and to lease the working of them. This raises the question of a traffic formula which shall induce the lessee to work the light railway in the interests of the public, by making the amount of his subsidy depend upon his doing so. The Belgian and Noblemaire's formulæ, Considère's formula, and Colson's modification of it come under brief review. The consideration of these and of MM. Considère's and Colson's controversy on the claims which light railways have, not only upon local but upon national support, as well as upon the most generous treatment by the main lines which they feed, cannot be without interest, and even practical value, to all who are interested in the light-railway question. The development of Italian tramways (which are—as in Belgium, France, and Holland—light railways on roads) shows that it is far more effective, in the long-run, to offer private enterprise a fair field, unhampered by harassing restrictions, than to afford direct pecuniary assistance in the form of Government subsidies. In Prussia the provincial and district authorities, but not the Central Government, may support the undertakings of other local bodies or of private persons. Light railways on roads are far more frequent on the Continent than they are likely to be in England.

In our Colonies and in the United States, uniform adherence to a standard of perfection has not been required, and, consequently, the necessity of making light railways a distinct class seldom arises. As will be seen in Chapter VII., these countries offer suggestive examples of the cheap construction of pioneer lines in undeveloped districts.

Facilities for the acquisition of land, and the early recognition of light-railway principles, wherever the utmost economy was essential, have already added a considerable mileage to our Indian railway system (Chapter VIII.). The "Branch Line Terms of 1896" and the near prospect of a stable exchange should attract British capital to the development of light railways in India.

Unlike England and Scotland, Ireland (Chapter IX.) is no stranger to State aid; and, apart from mere figures, the construction of light railways with State assistance has been a great boon to poor and remote districts. The Irish Act of 1896 is in line with the English Act of the same year.

Chapter X. devotes a brief space to traction engines, road locomotives, and other means of road transport which offer themselves as possible alternatives to light railways in certain cases; and their recent relief from certain disabilities which restricted their use has been described.

The interpretation of the Light Railways Act of 1896 is dealt with in Chapter XI.

The notion that a light railway must be a narrow-gauge railway is far too common. Light axle-loads and low speeds, not gauge, are the first conditions of cheap construction and economical working. Gauge is quite a secondary factor, the effect of which is very often exaggerated by the advocates of narrow gauges. Its influence on the cost of different items of expenditure is discussed in Chapter XII. Unless there are very special reasons to the contrary, light railways in England—short in length and making contact with the main lines—should be on the 4 ft. 8½ in. gauge. It is many years too late to wish that in India 4 ft. 8½ in. were the standard gauge, with the 2 ft. 6 in. gauge to fall back upon for those light railways which could not or need not make physical connection with the main lines in order to carry standard-gauge goods stock. *All the world over there ought to be two gauges only, the 4 ft. 8½ in. and the 2 ft. 6 in.*

Chapter XIII. on "Construction and Working" and Chapter XIV. on "Locomotives and Rolling-Stock" (and this explanation applies to the other chapters also) were not designed to form portions of a technical text-book on "Light Railways." That would necessarily include so much information regarding the construction, equipment, and working of ordinary, as well as of light railways—information regarding which is within the knowledge of railway engineers and within the reach of all—that I have simply endeavoured in those chapters to suggest or to recall the various details which admit of simpler and more economical treatment in the case of light railways. In no branch of expenditure is there more scope for economy in working than in the organization of the revenue staff—by employing cheaper servants than would be required on ordinary railways, by making the duties of the subordinate staff interchangeable, and by combining the supervision and administration of several departments under one head—and yet, in Chapter XIII., this important question is confined to one (the concluding) paragraph. The conditions of light-railway working must vary so greatly that suggestions for reducing establishment charges are best sought and considered in connection with the particular systems where such economies have actually been applied (see *Index*—"Economies in Construction and Working").

More precise illustrations of economical construction, equipment, and working are given in Chapter XV. (on "Light Railways in England, Scotland, and Wales"), which contains short studies of three light railways constructed before the Act—the Wisbech and Upwell Tramway, the Three Horse-Shoes and Benwick (Goods) Line, and the Easingwold Railway. Through the kindness of Col. G. F. O. Boughey, R.E., C.S.I. (one of Her Majesty's Light Railway Commissioners), I have been able to bring my information regarding light railways which come under the Act of 1896 as nearly up to date as possible.

Finally, my thanks are due to the General Manager, Locomotive Superintendent, and Mr Sherlock of the Great Eastern Railway, to the Honorary Secretary of the Easingwold Railway, to Messrs John Fowler & Co., to Messrs Kitson & Co., to the Leeds Forge Co., to Mr Everard R. Calthrop, to the representatives of the Colonies in London, to Mr A. S. Jameson (Locomotive Superintendent., E.B.S.R., India), and to many others, who have kindly placed information at my disposal.

W. H. C.

January 1899.

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LIGHT RAILWAYS
AT HOME AND ABROAD.

CHAPTER I.

DISCUSSION OF THE TERM "LIGHT RAILWAYS."

CONTENTS.—A precise definition difficult—Relation of other terms—Standard railways—Narrow-gauge railways—Portable railways—Pioneer railways—Disclassed lines—Feeder lines—Foreign terms—Tramways and tramroads—Sir D. Fox's interpretation—Sir John Wolfe Barry's description—The term as generally understood—Restricted by the Act of 1868—Undefined by the Act of 1896—Differentiation not a practical difficulty—Differences between standard and light lines in degree only—The same principles of rating, etc., applicable to both—Importance of light railways to agriculture—Road transport as an alternative.

Definitions of Terms.—The subject of light railways may be compared to a country which has no fixed frontiers, or to those Arctic lands whose northern limits are still unmapped. The reader's first and natural demand for a definition of the term "light railways" must be frankly met with the disappointing reply that a hard and fast definition, at once concise, exact, and comprehensive, is not forthcoming.

It is not easy to determine the exact point of divergence of light from *standard railways.* One is not necessarily divided from the other by the mere detail of gauge, for we may have a first-class railway, like the Rajputana-Malwa in India, on the metre gauge, and a light line, like the Easingwold in Yorkshire, on the standard gauge. The terms *light* and *narrow-gauge railways,* therefore, are not interchangeable. That *portable railways*—such as Messrs John Fowler & Co. or the Decauville Company supply—are light railways is obvious, but they represent a limited and extreme type.

Nor does the length or location of a line establish the difference between a light and a standard railway; for a *pioneer railway* may extend for two or three hundred miles and occupy a main trade route —until the pressure of a growing traffic compels its replacement by a more substantial system—in a new or poor country, where the choice lies between a cheap light railway and none at all. In richer and more prosperous countries, however, not only the main, but many of the branch and *feeder railways*, are already of the standard type; and the development of light railways will take place later, serving the remaining and less profitable districts and consisting of comparatively short sections. Any branch of a great system, upon which the traffic is either insignificant or purely local, might be disclassed and worked as a light railway. Thus, in Holland, some of the great companies have had certain sections of their lines classed as local railways and brought under the lenient conditions of the law of 1878; and, although this is less likely to occur in England, we already have reason to conclude that future branches and minor extensions of our great systems will frequently be made under the provisions of the Light Railways Act of 1896.

If we go abroad—as we must, in our study of the light railways question—we find the same merging and overlapping of terms, and a similar difficulty in determining their precise limits and in suggesting English equivalents. Thus, the Belgian system of light railways consists of *chemins de fer vicinaux*, which are generally laid on district or parish roads, and may, perhaps, be called by us district railways. The French speak of *chemins de fer d'intérêt local* or branch lines, as distinguished from *chemins de fer d'intérêt général* or through lines. Other terms are *chemins de fer affluents* or feeder lines, *chemins de fer secondaires* or second-class lines, *chemins de fer d'ordre inférieur* or third-class lines, *chemins de fer économiques* or cheap lines, and *tramways*, a term which is very differently applied in one country and another. These lines may, or may not, be *chemins de fer à voie étroite* or narrow-gauge railways, of any gauge less than the standard 4 ft. 8½ in., from 1 m. 20 cent. (3 ft. 6 in), first introduced in France in 1865, to the more general 1 metre (3 ft. 3⅜ in.) and smaller gauges, which are comparatively unfamiliar to us in England, but frequently adopted on the continent, in India, in our colonies and elsewhere. *Trains-tramways* entering a railway station will utilise the station lines to some extent, stopping on the main line to discharge their passengers, but leaving the road clear as soon as possible, and starting from a special departure siding. These tram-trains or way-trains stop at intermediate halting-places as well as at regular stations on their line. What are known as *trains-légers*, or omnibus-trains, run on the main lines of railway, are always light, and are often confined to one class of carriage. German terms met with are *Hauptbahnen* or main lines, *Secundärbahnen* or secondary lines, *Nebenbahnen* or branch lines, *Kleinbahnen* or light lines, and *Localbahnen* or local lines.

The terms light railways and tramways are so differently understood in one country and another that, as will be especially noticed in regard to Italy, much of the available information concerning light lines appears to be hopelessly confused. In France a line becomes a tramway if it is laid mainly on a public road. In Belgium it would still be called a railway. The English conception of a tramway is a line of rails sunk to the level of the street or road, so that ordinary traffic may use the way except when trams are passing; it implies, in fact, joint and not exclusive occupation of the space covered by the tramway. Accordingly, the space between the rails, as well as outside of them, is supposed to be paved or consolidated flush with the head of the rail, which is grooved to take the flange of the tram wheels. Such a construction of way is provided for in the Tramways Act of 1870, but it is not invariably carried out. The Wisbech and Upwell Tramway, for example, although laid on the side of a public road, has, with one superfluous exception, all the appearance of an ordinary railway. The rail, of the Vignoles or flat-footed pattern, has a check-rail bolted to it, so that, as originally intended, the road might be made up flush with the head of the rail. But the road is not so made up because the road authorities did not, after all, insist upon it, and the check-rail remains redundant, for the track is ballasted with stone or gravel in the usual way. The line looks like an ordinary railway, but it is officially classed as a tramway. This tramway—built, worked, and owned by the Great Eastern Railway Company—might this year have been built under the Light Railways Act of 1896 instead of the Tramways Act of 1870. Two further distinctions between railways and tramways are generally recognised; the latter pick up and set down passengers by the wayside, and they are not, as a rule, supposed to carry goods.

In regard to tramways it may be mentioned that in 1889 the International Railway Congress, assembled at Paris, resolved to abandon the application of the term "steam-tramways" (*tramways à vapeur*) to railways on roads. Town and suburban lines, worked by horses or other motive power, might be described as tramways; but the term cheap or light railways (*chemins de fer économiques*) should be substituted for steam-tramways in the case of all lines of rails laid wholly or partly upon roads, and designed to connect different centres of population. This agrees with our restricted use of the term "tramways." When the average Englishman talks of tramways, he means town and suburban tramways, as distinguished from "tramroads."

Tramroads are only dealt with in a Standing Order of the Houses of Parliament. Tramways are dealt with in the Act of 1870 [33 & 34 Vict. cap. 78], and require a Confirming Act, even where no compulsory powers of taking land are demanded. Until the Light Railways Act of 1896 was passed, the law specially affecting the construction and working of light railways was mainly contained in the Railway Construction Facilities Act, 1864 [27 & 28 Vict. cap. 121], and the Regulation of Railways Act, 1868 [31 & 32 Vict. cap. 119, Part V.]

Sir Douglas Fox,* more than thirty years ago, understood by light railways "such as, either being branches from existing trunk-lines or being intended for districts requiring the development of their traffic, should be constructed in a thoroughly substantial and durable manner, equal in their details as to quality to the best lines, but with every part made only of such strength as to carry loads represented by the rule that no pair of wheels should be allowed to have more than six tons upon it. This would enable those lines to carry the rolling-stock of all other railways of similar gauge, with the exception only of the locomotives." He instanced the railway system of Norway as an example, being "on the light principle, and of the 3 ft. 6 in. gauge." Above high-water level the superstructure of the bridges (including the Warren trusses) was of timber; the station buildings were of timber; the rails weighed 37 to 40 lbs. per yard; the sleepers, laid 2 ft. 6 in. apart, centre to centre, were of creosoted pine, with the round side up, and adzed to increase the bearing surface; and the cost was £6000 per mile.

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* "Light Railways in Norway, India, and Queensland," *Min. Proc. Inst. C.E.*, vol. xxvi., 1866-67.

Although Sir Douglas Fox's description referred particularly to the light railways about which he was writing, it applies very fairly to what we mean by light railways at the present moment. His definition is essentially an engineer's, and ceases with the construction of a comparatively cheap line, but economy of working is, of course, implied. Although the example quoted is of a narrow-gauge line, his definition is independent of any limitation in that respect; while his careful provision for the use of rolling-stock belonging to heavier lines absolutely demands continuity of gauge. The scope of his definition would have been wider if he had abstained from prescribing a maximum axle-load.

Apart from the detail of gauge—in regard to which his opinions are very decided—Sir John Wolfe Barry's presidential address* to the members of the Institution of Civil Engineers, on the 3rd of November 1896, contains a freer description of what English light railways should be generally. "So far as works are concerned," said the President, "a light railway should be similar, but slightly superior, to the temporary or service lines made by contractors in constructing the ordinary standard lines. The rails, sleepers, and ballast should merely be adequate for a limited weight upon the wheels of a suitable locomotive, which need not be heavier for the wider gauge, while the earth works may be light, as the gradients for moderate loads may be steep. Bridges over and under roads will be in most cases unnecessary, and Board of Trade safety appliances should be greatly simplified, but the gauge should be unbroken at the point of contact."

Relation between Light Railways and Standard Lines.—A light railway, then, in regard to length and location, may occupy, as a temporary or pioneer line, an extensive main route capable of future development; or it may form a short feeder to an existing system; or it may complete minor connections; or it may be a purely local and independent line of short length. It may be laid on a road, if land outside is costly, and the width, grades, and bends of the road are suitable. It may be of standard or less gauge, according to circumstances. But, economy being essential, we shall expect to find a single line, a lighter rail, slower speeds, lighter axle-loads, and—in regard to staff, brakes, block-working, road crossings, signalling, interlocking, station arrangements, etc.—less stringent requirements than are demanded on standard railways. In addition to exceptional economy in construction and in working, we shall require a cheaper and simpler legal and parliamentary procedure than that prescribed for standard railways, facilities of promotion, cheap land, and assistance—possibly financial—from individuals, from local bodies, and, in special cases, from the State.

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* *Min. Proc. Inst. C.E.*, vol. cxxvii. of 1897.

The term "light railways" is first used officially, and its application is in two particulars limited, in the Regulation of Railways Act, 1868 [31 & 32 Vict. cap. 119], which restricts the axle-load to eight tons and the speed to twenty-five miles an hour. The Light Railways Act, 1896 [59 & 60 Vict. cap. 48], does not commit itself to details of this sort. It very prudently and properly leaves it to the Commissioners and to the Board of Trade to decide the claims of each project, as it comes before them, to be dealt with under that Act.

A complete definition, covering all the ground, if not impossible, would be too complicated for ready application to every case; a partial definition would frequently be misleading. While, however, we lack a definition at once concise, exact, and comprehensive of the term "light railways," the Commissioners and the public are well able to form a very fair opinion on the claims of any proposed line—taking into account its objects, its position, its construction, its equipment, the nature and extent of its traffic, and its working economies—to be considered and treated as such. In the differentiation of light railways from standard railways, therefore, there appears to be no ultimate difficulty; and to their practical association there should be no serious obstacle.

We may say, roughly, that a light railway might be (1) absolutely local and independent in its entertainment of traffic, or (2) contributive to an existing main line, or (3) competitive with a main line. If the first condition obtains, no main line has any direct concern with the light railway; if the second, the main line should encourage the branch in the most generous manner; and the third condition should never be allowed to take effect—in fact, we may safely assume that the Commissioners will never permit the Act to be applied to the prejudice of an existing standard railway.

As the differences between a standard and a light railway are not in kind but in degree, and both are intended to discharge identically the same functions, light railways will have to be worked, not as benevolent institutions, but on the same business principles as standard railways. Light railways have been called for mainly in the agricultural interest. It is hoped that they will place the British producer on at least equal terms with his foreign competitor. Their success will largely depend upon his intelligent co-operation, and also upon their being allowed a very free hand in the fixing of rates.

The next chapter will be devoted to a brief consideration of the principles which determine the application of rates, the relations of railways generally to agriculture, and the demand for light railways as feeders to tap the country districts.

Other methods of transport, not on rails but on the ordinary surface of the public road—by means of road-locomotives, traction-engines, auto-motors, etc.—call for some notice, because they are often capable of performing the very services required of a proposed light railway, and later on, therefore, a brief chapter will be devoted to them.

CHAPTER II.

ENGLISH RAILWAYS, RATES, AND FARMERS.

CONTENTS.—English roads and canals—Development of railways—Statistics for 1896—Passenger fares and rolling-stock—Goods rolling-stock—Goods rates and tolls—Equal mileage principle inapplicable—Cost of service indeterminable—Factors affecting cost of service—Rates dependent on what the traffic can bear—Solacroup's statement of the rule—General classification of goods an illustration of it—Differential rates—Group rates—Government control of rates—Railway Commission under Act of 1873—Railway and Canal Commission under Act of 1888—Provisions of the Act of 1888—Statistical returns—Maximum rates—Undue preference—Competitive rates—Import rates and the British farmer—Kentish hopgrowers—Packing produce—Recent reductions of rates for home produce—Agricultural returns—Report issued in 1897 by the Royal Commission on Agriculture—Light railways required—Facilities afforded by the Light Railways Act, 1896.

Development of Traffic Routes.—It has never been considered in England to be the business of the State to initiate, plan, and construct the roads and canals in accordance with a regular and comprehensive system, such as that which, in France, originated with Colbert and was perfected by Napoleon. Private enterprise has, from the first, determined the development of our internal communications.

English roads seldom followed the best alignment, and were often steeply graded. These defects render them peculiarly unsuitable, in many instances, for the laying of light railways upon them. The fault did not necessarily lie with the surveyor, for his choice of route was limited by the necessity of skirting the boundaries of fields and estates belonging to landowners whose privileges would not yield to public interests. The canals, however, offered so efficient a means of communication, and commanded such powerful influence, that they constantly presented the most formidable opposition to the introduction and development of railways. But time brings its revenges, and the position was exactly reversed when the Manchester Ship Canal came to be made.

The most striking features of modern railways are the running of vehicles with flanged wheels upon two steel rails, and the haulage of trains, consisting of such vehicles, by steam locomotives. More than 220 years ago coal wagons were drawn on timber rails by horses. A century later iron rails, nailed on wooden sleepers, were laid at the Sheffield colliery. In course of time, plate rails of cast-iron were replaced by edge rails of malleable iron, and the wheels were flanged. The history of modern railways has been dated from the construction of a line between Wandsworth and Croydon, which was sanctioned in 1801, to be worked by horse traction.* Then followed Huskisson's decisive defeat of the canal opposition, the sanction of the Liverpool and Manchester Railway in 1820, and the completion of the Stockton and Darlington line in 1825. But the most important starting-point of modern railway progress must be referred to the success of Stephenson's locomotive, the "Rocket,"—with its blast-pipe, multi-tubular boiler, and springs,—in 1829. The contrast between Stephenson's engine and the modern locomotive, in regard to power, weight, and speed, is, indeed, sufficiently striking; but it is possible that we are about to make a still more startling development by the substitution of electricity for steam as the motive power. And while, in light railway work, we revert to rails and axle-loads lighter than those that prevailed in early days, it is not unlikely that we shall discover in so modern a motive-power as electricity the best and cheapest for our purpose under certain conditions.

Comparing our modern steam engine with that of sixty years ago, we find that, with a steam-generating surface three times as great, and nearly four times the steam-pressure, its power is ten-fold greater. Increasing axle-loads and higher speeds have required the adoption of heavier rails, and these have for many years been made of steel instead of iron. English passengers accept the speed, comfort, and safety with which they travel as a matter of course. The rapid succession of fast trains is due to the laying of double lines and the perfection of the block system. Safety appliances have been multiplied almost to excess. The development of through routes has been remarkable. In all the advantages of modern travelling the third-class passenger shares, for his paying value has long been recognised. It is now not merely economical, but almost fashionable, to travel third-class, and third-class accommodation is provided on nearly every train. The convenience and speed of the goods service are still more notable. Terminal facilities have been so perfected that the conveyance of goods is almost literally from the door of the producer to that of the consumer; and in regard to collecting, loading, unloading, delivery and other services connected with the despatch of goods, English arrangements are far ahead of those which prevail elsewhere.

In order to bring our appreciation of railways in the United Kingdom as nearly as possible up to date, the following figures may be quoted from the *Railway Returns for* 1896:—

Capital—	
Ordinary,	£380,073,903
Total,	1,029,475,335
Length of line open—	
Double or more,	11,589 miles
Single,	9,688 ,,
	21,277 miles

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* Hadley's *Railroad Transportation*, p. 9.

Receipts—	
Passenger,	£39,120,865
Goods,	46,175,335
Miscellaneous,	4,822,922
Total,	£90,119,122
Working expenditure,	50,192,424
Net earnings,	£39,926,698
Locomotives,	18,956
Carriages, wagons, trucks, &c.,	692,754

In Messrs R. Giffen and F. J. S. Hopwood's Report * to the Board of Trade, the following figures are given:—

Percentage of net earnings on capital,	3·88
Dividend paid on ordinary capital,	4·29
Per train-mile—	
Receipts from traffic,	57·93d.
Expenditure, exclusive of harbour, &c., expenses,	32·41d.
Net earnings,	25·52d.

And the expenditure per train-mile is thus distributed:—

Maintenance of way,	5·54d.
Locomotive power,	8·81d.
Rolling-stock,	2·90d.
Traffic expenses,	10·56d
General charges,	1·48d.
Rates and taxes,	2·13d.
Government duty,	0·19d.
Compensation—	
Personal injuries,	0·08d.
Damage to goods,	0·18d.
Legal and Parliamentary expenses,	0·20d.
Miscellaneous,	0·34d.
Total working expenditure per train-mile,	32·41d.

Conditions Regulating Traffic Rates.—Passenger fares in England compare very favourably with those of other countries. A passenger in an ordinary American car may be charged an average of 1d. per mile, in an English third-class carriage somewhat less; but our first and second-class fares are higher than those which include the use of the American special cars. Continental fares, taken with their drawbacks and our advantages—*e.g.*, our provision of third-class accommodation on almost every train, and allowance of 60 lbs. of luggage free of charge—are seldom, in the long run, lower than ours, while the barriers, formalities, and tedious methods of dealing with luggage, which are suffered on Continental railways, would be intolerable in England. Indian fares are, of course, exceptionally low. A third-class fare of ⅓d. per mile is the highest that can be levied, and could only be levied, in a country where the wages of the railway *employé* and of the ticket buyer are extremely low. Neither the wages nor the fares can be compared with ours, for in India the necessaries of life are cheap and the conditions are easy to the native, however costly the former and difficult the latter may be to the Englishman in India.

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* Herapath's *Railway Journal*, 29th October 1897.

With our passenger carriages, although they may be only 7½ feet wide, as compared with 9 feet in America, we may well be content. The third-class passenger now-a-days is provided with roomy and comfortable compartments, and finds a dining car attached to long-journey trains. Our goods stock are more open to foreign, and especially to American, criticism. If we have utterly discarded the defunct stage-coach as a pattern for passenger carriages, our goods wagons—these critics say—are still little better than the colliery trucks placed upon the earliest railways. An Indian standard-gauge covered wagon, taring only 7 tons 10 cwts., will take a load of 16 tons 10 cwts., and an American freight car, weighing only 18,480 lbs., may have a capacity of 56,000 lbs., while an English truck may tare 4 tons 16 cwt., and not take more than an 8-ton load. The difference in stock is chiefly due to the difference in conditions. If Indian and American railways did not build for a higher ratio of paying to dead load, they would never bring their wheat to the English market. Full train-loads of full wagon-loads are of the first importance. On the contrary, short lead, light loads, and rapid transit are essentially characteristic of English goods traffic. Our wagons have to be moved about in yards and sidings by horse-power, and an 8-ton truck is quite as much as a single horse can fairly manage. There is much to be said, therefore, for preferring 8-ton stock, and 10 tons may be regarded as the extreme limit. As a matter of fact, the full capacity of a truck is seldom tested. The contents may be bulky, or it may not be convenient to put more than one consignment in the truck, so that in either case a mere fraction of the full load is frequently carried. The division of receipts between one railway and another is based upon so low a minimum load as 1 ton. Economy of time rather than of load is the first *desideratum*. An express goods train may slip or pick up a wagon at a station, but it has no time to spare for dealing with mixed consignments in one wagon. Where a wholesale traffic in wheat, hog products, etc., is offered for haulage hundreds of miles from the interior to the port, full trains of fully-loaded wagons —specially designed for a high percentage of paying to dead load—

are essential to economical working. But in England the traffic is largely made up of small consignments of a high class, manufactured articles, mixed goods, &c., and speed and convenience are of more importance than economical loading. A few figures will show how different the conditions of traffic in one country and another may be. In England the goods receipts are only 51·2 per cent. of the whole, the passenger receipts amounting to 43·4 per cent.; yet no less than 619,081 vehicles are required for the conveyance of live stock, minerals and general merchandise, while 42,284 carriages are sufficient for the passengers. In India the goods receipts make up 60·6 per cent. of the whole, as compared with 36·2 per cent. from passengers; but 49,524 standard-gauge and 27,424 metre-gauge vehicles are enough for the goods, while 7078 standard-gauge and 4903 metre-gauge carriages are required for the passengers. The conditions of traffic in England demand a much larger proportion of goods rolling-stock.

Comparison between goods rates in England and in other countries is almost impossible. The classification of passengers is simple enough; in Sir James Allport's words, they load and unload themselves; and it is convenient to charge them on a mileage basis. The classification of goods, on the other hand, is most complicated. English goods rates generally include collection and delivery, so that comparison with foreign rates, which do not include such services, would not only be difficult but unsatisfactory and misleading; and to express English goods rates as multiples of the mileage is utterly impracticable.

From the first the construction of each railway required a special Act, and the new railway Acts were framed on very much the same lines as canal Acts. Railways were regarded merely as a new form of highway, upon which traders paying certain tolls would run their own trucks, just as the users of roads loaded their own wagons or users of canals carried their cargoes in their own barges. Railway charges accordingly took the form of tolls, and were so scheduled in the Acts. The supply of trucks by the traders instead of by the railways still survives, and the theory of equal-mileage rates—or the application to the same kind of goods of the same charge per mile throughout, a theory natural to a system of tolls—is not yet wholly dead, although traders must know that, of all the factors which affect the cost of working, distance is generally the least important.

The **equal-mileage** principle, if applied to rates, would favour short-distance traffic most obviously and unfairly—for a charge depending on a short mileage could not possibly cover those expenses which are independent of distance—while it would be absolutely prohibitive in its effect on the great bulk of long-lead traffic. How large a proportion of the total expenses, even in the latter case, may be assigned to terminals, is shown by Mr A. M. Wellington's statement that they account for three-fifths of the whole rate of goods from Chicago to New York.*

The equal-mileage basis of rating was thrown out by the Joint

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* *Railway Location*, by A. M. Wellington, p. 820.

Committee of 1872 and by the Royal Commission of 1876 on the ground that it "would prevent railway companies from lowering their fares and rates so as to compete with traffic by sea, by canal, or by a shorter or otherwise cheaper railway, and would thus deprive the public of the benefit of competition, and the company of a legitimate source of traffic." It would, of course, be grossly unfair to the railways, but it was rejected in the interests of the public.

Any endeavour to adopt actual **cost of service** as the basis of charge would be disastrous to the development of business. Fortunately, the cost of service cannot be determined; and, even if it could be determined, it could not be applied; and, even if it could be applied, the great bulk of goods traffic could not pay it. No one could fairly distribute the exact share of movement, station, clerkage, terminals, maintenance, and other expenses, or of interest on capital, which each item of traffic should bear.

Speed, bulk, risk, trouble, quantity, regularity of shipment, back-loading—all these are at least as potent factors in the cost of transportation as mere distance; and, in considering a rate, the experienced manager thinks of every detail. For all practical purposes he can reckon up the cost of hauling a train over a certain section. He may consider that 13d. a mile will about cover the cost of working a certain train (an Indian railway manager might put it at Rs. 1 a mile) and thus decide whether it is worth his while to keep this train on or to take it off. What he wants is to increase his net revenue. If an expansion of business offers, which will increase his gross earnings faster than it will increase his working expenses, he will be inclined to undertake it. It may not pay its full share of the fixed charges—expenses which must be incurred on the minimum of traffic, such as the irreducible permanent establishment and interest on capital—but, whatever it brings in, over and above the actual cost of movement and handling, is an addition to net revenue; and "additional traffic we have seen to be that on which railways grow rich." *

Thus it is that—having discarded the "equal-mileage" basis of rates, a survival of the "toll" system and absolutely destructive to long-lead traffic, and the "cost of service" principle, depending on a unit which is variable, indeterminable, and inapplicable—we arrive at the only practicable solution, "charging what the traffic will bear." The rule was thus stated by M. Solacroup (director of the Orleans Company of France):—"In the matter of transport tariffs there is only one rule, viz., to ask of merchandise all it can pay; any other principle is no principle." This, as has repeatedly been explained, does not mean charging more than the traffic can bear, nor does it mean lowering the rate after the ultimate expansion of traffic in a particular commodity has been secured. In the very early days of competition between railways and canals it was supposed that only goods requiring rapid conveyance would be able to bear charges high enough to pay interest on undertakings so costly as railways. The adaptability of railway rates to low-class traffic was not immediately recognised. The prosperity of railways is founded on the rule of trade which seeks for profit on even the most costly plant and machinery in quantity of output rather than in high prices, and the maximum traffic in any commodity is obtained by lowering the rate to what the traffic will bear.

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* *Railway Location*, by A. M. Wellington, p. 726.

The first application of this principle is seen in the "General Classification of Goods," which is based partly upon the bulk and other features, but mainly upon the *value* of the goods. A few examples may be quoted.

Unless otherwise provided, the rates for goods in Classes 1 to 5 include collection and delivery within the boundaries prescribed by the companies at the various places. The rates do not include collection or delivery of any article weighing more than three tons, nor of any article which, by reason of its shape or dimensions, cannot be conveniently and safely carted on a vehicle ordinarily used for general merchandise.

The highest rates are applied to goods of Class 5, such as live poultry, furniture in cases, etc.

Eggs in hampers or sieves (subject to a lower rate if booked at owner's risk), dead poultry, furniture in van bodies, etc., are assigned to Class 4.

In Class 3 we find eggs in boxes or crates, cotton goods in bales or boxes, milk, apricots, cherries, raspberries, strawberries, etc.

To Class 2 belong cherries, raspberries, and strawberries in tubs for jams, etc.

Hay, not compressed to a certain density, comes in Class 1; so do herrings, cod, ling, and—if determined by measurement—timber. Potatoes in casks, if in less than two-ton lots, are included in Class 1.

But potatoes in casks in two-ton lots are more leniently treated in special Class C, and firms may sometimes obtain rebates on larger quantities. In this class, too, we find hay machine-pressed to a minimum of 2½ tons per truck, timber reckoned by actual machine weight, carrots, cabbages, wheat, vetches, oil-seeds, rice, oats, malt, flour, beans, barley, and other grains. Class C is applicable to consignments of two tons and upwards.

Classes B and A are applicable to consignments of four tons and upwards.

In Class B are included manure in bulk, common and fire-clay bricks, roofing tiles, mangel-wurzel in bulk for cattle, etc.

Limestone in bulk, fire-clay, coke, coal, etc., are placed in Class A, and for these the lowest rates are quoted. An additional charge is made for the provision of wagons for Class A goods.

Articles exceptional in bulk, length, or weight, or insecurely packed, specie, bullion, gold or silver plate, precious stones, etc., are carried by special arrangement.

If the quoted rates include cartage, rebates are given for cartage done by the shipper. Concessions may also be granted in such matters as warehouse rent, siding rent, demurrage, etc.

To enable long-distance traffic to reach the market, differential rates may be applied, so that the charges shall increase much more slowly than the mileage. Thus, if the rate is cumulative, we may pay, for the carriage of 14 lbs. of farm and dairy produce, 6d. for any distance not exceeding 50 miles, 7d. for any distance not exceeding 100 miles, and so on; in which case we are charged 6d. for the first 50 miles, and 1d. for the next 50 miles. Telescopic rates of this sort do not overlap. But when a certain rate is charged per ton per mile for any distance not exceeding 100 miles, and a lower rate for any distance greater than 100 but not exceeding 200 miles, and so on—the rate being on a graduated scale—the cost of carriage over a greater distance may be less than that over a shorter distance. It is as if a tradesman's offer of "making a reduction on taking a quantity" took the form of charging a customer 1s. a-piece for 100 articles or 9d. a-piece for 120. To correct this overlapping, the rate might be raised *forward* by not charging less for the greater than for the shorter distance; or the rate might be lowered *backward*—on what the Americans call the "short-haul" principle—the rule being that the charge for the lesser distance or weight shall not exceed the charge for the greater. In one case a forward, in the other case a backward, group rate is introduced. The latter is the differential rate generally applied in India.*

A group rate, however, as generally understood, is a uniform rate applied to a number of places in the same district, situated at various distances from any point of destination or departure of merchandise. By thus grouping all the stations within a certain area, petty advantages of geographical position are discounted, and the whole of a producing district—within reasonable limits—may be placed upon the same footing, to the great advantage of the public.

Government Control of Rates.—That the application of railway rates should be subjected to some extent to control by higher authority will be admitted, but for very special reasons it would be grossly unjust if the exercise of this control prevented railways from earning a fair profit on their whole business. Their capital is not, like that of bankers or shopkeepers, transferable to some other sort of business, but is permanently sunk in the provision of one thing only—the means of transportation—which, if not bought, is useless for any other purpose, and, if bought, must be paid for at a proper price. On the other hand, it must be conceded that railways—the destroyers of local and physical monopolies—are themselves partial monopolists. The inevitable quotation may as well be made here as elsewhere, "Where combination is possible," said George Stephenson, "competition is impossible." Rate-cutting was abandoned as a weapon not merely murderous but suicidal in its effect. By one means or another—by amalgamation, by combination, by agreements to maintain rates, and by pooling the field, the traffic, or the joint earnings—competition has, it is said, been so far killed that each railway commands certain routes, and holds, within a recognised area, a monopoly of transportation. This is true in a measure, although the competition has mainly shifted from the field of rates to that of speed, convenience, and facilities of every kind, to the great advantage of the passenger and trader; but it is only true, and partially true, as between one railway and another. Admitting, however, that railways are partial monopolists, we must also acknowledge that, to a limited extent, they are public corporations.

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* Appendix vi.—*Goods Tariff, N.W.R., India*, para. 43.

Mr A. B. Stickney (President of the Chicago Great Western Railway Company) observed* that a railway is neither a private nor a public corporation, but what he calls a *quasi*-public corporation. The power and duty of providing highways is exclusively and inalienably vested in the Sovereign or Government. This implies the right and duty of the latter to control rates. Rates are not a *quantum meruit* for specific services, but tolls. A toll is a tax. Therefore, railway rates are taxes, and all the rules applicable to the levy of taxes apply to the levy of railway tolls or rates.

We shall venture to dissent from nearly all these statements which are included in Mr Stickney's argument. It is not necessarily the business of the State to make highways; a people like the English would rather have their highways made by private enterprise or local bodies. A railway is not a highway. Rates *are* a "*quantum meruit*" for definite services rendered. Rates are not tolls, and, therefore, they are not taxes. With Mr Stickney's conclusion, however, that it is the duty of a railway so to raise or lower rates as to produce the largest revenue, we readily agree.

As providers of a public use, railways claim such rights as the compulsory acquisition of land and other property. As private corporations, they resent the interference of the State in the details of their business. Whichever position they take up, there are drawbacks as well as privileges to be accepted. Mr Stickney's term—*quasi*-public corporations—is not inapt; and there must be over such bodies some sort of controlling and arbitrative power exercised by Government, both in respect of rates and other matters. Such power was vested in the Railway Commissioners by the Act of 1873, and transferred to the Railway and Canal Commissioners by the Act of 1888.

The Railway Commissioners appointed under the Regulation of Railways Act of 1873 could compel rival railways to take joint action for the public convenience, make the companies define their liability for damage or loss of goods during transit, enforce through rates, and ensure publicity of rates. The Commission was neither an executive body nor a court of law, but a technical tribunal. It might consider the complaint of a shipper on a question of discrimination in rates, or the demand of one company for running powers over the lines of another; but, if a point of law arose, the case had to be stated for submission to a court of law. It lay with the Commissioners, however, to decide whether the question at issue was one of fact merely, or one of law.

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* *Bulletin of the International Railway Congress*, vol. x., July 1896.

By the Railway and Canal Traffic Act, 1888 [51 & 52 Vict. cap. 25], the jurisdiction and powers of the Railway Commissioners were transferred to their successors, the Railway and Canal Commissioners. This new Commission consists of two appointed and three (for England, Scotland, and Ireland) *ex-officio* Commissioners. To them complaint may be made by certain local authorities, or by any association of traders or freighters, or chamber of commerce or agriculture, recognised by the Board of Trade. They may hear and determine questions of traffic facilities, undue preference, works for public accommodation, the legality of tolls, rates, or charges, the apportionment of expenses between a railway company and applicants for works, etc.

Part II. of the same Act requires every railway company to submit to the Board of Trade a revised classification of merchandise traffic, and a revised schedule of maximum rates and charges applicable thereto. These must declare the nature and amounts of all terminal charges proposed to be made in respect of each class of traffic; and such terminal charges must be justified by "expenditure reasonably necessary." The classification and schedule, as determined by a Provisional Order of the Board of Trade, require confirmation by an Act of Parliament. Provisions are made for through traffic and through rates, and the apportionment of the latter. The burden of proving that a difference in rate or of treatment, as between one trader and another, is not an *undue preference* is thrown on the railway company, but the Court or Commissioners must consider whether the difference in rate or treatment is necessary for the purpose of securing the traffic in the interests of the public. Group rates are expressly permitted, provided that they do not create an undue preference and the distances are not unreasonable. The Board of Trade may deal with complaints of unreasonable rates of charge, and may report to Parliament upon them. Railways must in their returns furnish such statistics as the Board of Trade may require. Every company must allow any person to inspect the classification table, or buy copies, with the authorised schedule of maximum charges. The railway must disintegrate a rate, if so required by any interested person, and distinguish the charge for conveyance from terminal or dock charges. Rates are to be open for public inspection.

Part III. applies similar provisions to canals; and Part IV. perpetuates the Act of 1873, and deals with miscellaneous matters.

Of the questions referred to in the Act of 1888, a few call for further remarks, *e.g.*, the statistics contained in the returns, the maximum rates and charges, and undue preference.

The Commissioners have not such a volume of statistics at their disposal as are demanded in other countries. English railway companies will tell you how many passengers and how many tons of goods they carry, their gross receipts from passenger and goods traffic, the train-mileage of each description, their working expenses, net receipts, and quantity of rolling-stock. Such details are a practical expression of the whole amount of business done. In the average cost of hauling a ton of goods or carrying a passenger one mile, in the average number of tons in a train, in the average load of a goods vehicle, and in 200 similar items of statistics which afford the Government of India an opportunity of making comparisons between one railway and another, and supply it with data for criticism, English general managers take no interest whatever. "You can always," said Mr Grierson, "get the average, and work it out as a curious calculation, but I do not see how it would enable you to get more profit, or to reduce your expenses, or to increase your trade." The method of the railway manager is to deal with each case as it crops up, and this is more or less true also of the Railway and Canal Commission, and of English railway legislation. Great Britain has, says Professor Hadley,* "settled down on the policy of specific laws for specific troubles." There can be no better policy; it is simple, practical, and Anglo-Saxon.

In discussing the Light Railways Act of 1896 later on, we shall notice that it requires a provision to be inserted in the Order, fixing the maximum rates and charges for traffic. It has often been said that the statutory maxima are so much higher than the existing charges that they are practically inoperative. The present Schedules probably are not so lenient, and in some cases the maxima may have the effect of unduly forcing down the rates.

The burden of proving that a difference in rate or treatment, as between one trader and another, is not undue preference is laid upon the railway. If a special rate is given to one trader, it must be given to all traders under the same conditions, but it cannot be condemned as preferential if it is the result of fair competition. We have seen in what way differential rates may be applied to the relief of long-distance traffic. It is conceivable that special rates might be quoted on account of full train loads and full wagon loads, and that such rates would not constitute undue preference, if it could be shown that traffic thus offered was more conveniently and cheaply handled. When, however, it was proposed, at the session of the Joint Select Committee in 1891, to carry coal more cheaply when it was so offered, Sir George Findlay, Mr Frederick Harrison, Mr Henry Lambert, Sir Henry Oakley, and other experts, opposed the introduction of rates which they considered unduly preferential to the large consignor. There was the moral objection to a principle which, in its application, would destroy the small traders and establish the monopoly of a few great traders. There was the economic objection that such consignments cost just as much as others to work, conduct, and convey. And there was the practical objection, that nobody could say what was a wagon load or a train load. As Lord Balfour of Burleigh observed, "it seems to us no more easy to say what are the contents of a truck, or what can be hauled in a train, than to specify any quantity by saying that it is as big as a lump of chalk, or as long as a piece of string, the conditions vary so much." Differential rates are, however, quoted for consignments of certain goods offered in convenient quantities, such as 2-ton and 4-ton lots.

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* *Railroad Transportation*, by Arthur T. Hadley.

Again, those who sweepingly assert that railways are monopolists cannot be aware of the extent to which water competition—by sea coast, by navigable river, or by canal—affects railway rates. These have to be lowered towards the canal rates at certain places, and frequently give rise to complaints of undue preference. The railways are, however, held to be justified in quoting competitive rates at competitive points. Thus, a canal rate for grain of 4s. 6d. or 5s. might compel the Great Western Railway to quote 5s. 10d. between Gloucester and Birmingham, although the railway maintained a higher rate, say 6s. 8d., between Cheltenham (a nearer but a non-competitive station) and Birmingham.

Import Rates and the British Farmer.—But of all competitive rates, those most bitterly attacked—especially by the British agriculturist—are the **import rates** which bring to our market grain, wool, cattle, poultry, meat, dairy produce, etc., from abroad. The railways push their way to the ports, establish their wharves, link themselves directly with the sea-borne traffic, and, by quoting lower rates than they offer to internal traffic, secure the carriage of imports which, otherwise, would go to London by sea.

Import rates are the natural result of competition and free trade. Railways can scarcely be called upon to adopt a protective tariff against foreign produce, although they may be expected to meet the reasonable demands of the English agriculturist. He cannot fairly describe such import rates as *premia* against home production, and it behoves him to consider, not only whether the rates are justifiable, but whether it would really do him any good, or merely do the railway harm, to minimise such rates. On this point *The Times* of the 4th of February 1896 offers some significant remarks, which deserve quotation:—

"Sometime ago the Kentish hop-growers represented that they were being seriously prejudiced by the importation of foreign hops, and asked if nothing could be done in their interests. The company accordingly adopted the extreme course of refusing to carry any foreign hops whatever. But the foreigners met this by arranging to send their hops all the way to London by water; and they found, much to their satisfaction, that they could do so cheaper than when they had to pay full railway rates from the coast to London. The result was that the foreigner became a stronger competitor in the London market than he had been before. The Kentish growers sent no larger supplies than they had done previously, and the South-Eastern Railway Company found that they had sacrificed an important item in their goods traffic without doing good to any body except the very people they had intended to injure."

It is not enough to reduce through rates and local rates to the same level. To "boycott" foreign produce altogether is equally useless, since it will certainly find another, and possibly a cheaper, route by sea. The fact is that the English farmer persists in bringing his "pig to market"—or whatever it may be—in the most troublesome and irregular fashion. He may be radical enough to revolutionise rates, but he is terribly conservative in his methods of business. At any green-grocer's shop we can see how admirably and yet how simply and cheaply foreign fruit and vegetables are packed. The difference lies, as Mr Acworth* points out, between the English farmer's basket of eggs and the American car loads.

English growers surely have every advantage on their side in the supply of fruit, for the foreign producer has at least to face two railway journeys, a sea voyage, and the corresponding transhipments. Yet this is what Mr Williams† has to say:—

"In the fruit business proper packing is a prime essential; and in this matter our people are, of course, far behind the foreigner. Mr George Munro, of Covent Garden, stated, at the Crystal Palace Fruit Show in 1894, that English fruit-growers were getting worse instead of better. He also said—it sounds incredible, but Mr Munro is an authority—that, 'although we have continually improved where there is no competition, we have degenerated to a great extent where there is, and have so far played into the foreigners' hands, who study the requirements of the trade, and try in every possible way to meet them.'"

Again, while the Hampshire farmer—as *Transport* ‡ observes—consigns one or two hundredweights of meat, all hanging on hooks and demanding constant and special care, there may be in the very same train tons of French, Danish, or Canadian meat, each piece wrapped in its own canvas covering, and so well able to take care of itself. Then there are the English farmers' unwieldy masses of forage, taking twice the room of more neatly compressed foreign hay. The farmers must learn to pack their produce properly, organize their business, form local centres, and combine in making up large consignments. In short, "the interest of farmers will ultimately be best served by the concentration of produce and by its carriage in large quantities to the market salesman." §

In the meanwhile, farmers are being assisted by reduced rates even for small quantities of produce. Thus, we find that the Great Western Railway will, at owner's risk, carry (not to a private individual, of course, but) to a market, a salesman, or a dealer, butter, cheese, cream, fish, eggs, game, poultry, fruit, vegetables, meat, etc., in a 10 lbs. consignment, 100 miles for 6d., 200 miles for 8d., and above 200 miles for 9d. If the consignment weighs more than 24 lbs. the charge is only ⅛d. per lb. for 30 miles, ¼d. for 50, ⅜d. for 100, ½d. for 200, and ⅝d. for more than 200 miles.

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* *The Railways and the Traders*, by W. M. Acworth.

† *The Foreigner in the Farmyard*, by Ernest Edwin Williams.

‡ *Transport*, vol. vi., April 19, 1895, pp. 353–354.

§ *The Times*, December 24, 1895.

The Great Eastern Railway* was early in the field with a reduced charge of only 4d. for every 20 lbs. of farm produce and of 1d. for every additional 5 lbs. up to 60 lbs., including delivery within the usual limits. These favourable rates were immediately compared with other existing rates, but it had to be remembered that the new rates would only apply where certain conditions were complied with:—(1) The produce had to be packed in boxes on sale at different stations, or similar ones. (2) The boxes were to be secured by nails, and not by rope or cord. (3) The produce would be conveyed at owner's risk and carriage prepaid. (4) The box should not weigh more than 60 lbs. The conditions, in fact, were such as were already complied with by foreign producers, and such as made it possible for the railway companies to quote lower rates.

The farmer's difficulty in obtaining payment for the boxes in which he sent his produce was pointed out, and it was suggested that it could be overcome by the introduction of the "Value Payable Post" system, which is such a boon to India.

About the same time † the London and South-Western Railway introduced reduced rates from non-competitive stations for fruit and vegetables in classes C and 1 and 2 of the general railway classification in small consignments of 1 cwt. and upwards, the rates including delivery by cart in London within the usual boundaries. The reductions generally amounted to as much as 20 to 30 per cent. Some excellent instructions were also issued by the goods manager. He pointed out that if the farmers were clearly told at what low rates large consignments would be conveyed, and if the senders would combine to concentrate their consignments, they would considerably reduce the cost of transit and be able to place a far larger quantity of their produce on the London market.

As an example, Mr Henry Rew (one of the Assistant Commissioners on Agriculture) reported that a carrier was able to collect poultry from the different breeders in and around Heathfield in Sussex, to concentrate the produce, to consign it to London, pay the ordinary railway rates, deliver it in the market, and charge the poultry farmer only 1d. per bird. In the face of this, how can it be said that English poultry is kept out of the market by the railway rates?

The London and North-Western had, so long ago as 1893, in their general revision of rates largely reduced their charges for the carriage of home-grown produce. In milk rates, the reduction was in many cases as much as one-third. The company's canvassers, in the course of their careful and wide enquiries, interviewed as many as a thousand farmers, and the following is a summary of their report ‡:—

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* *The Times*, November 14, 1895. † *The Times*, December 24, 1895.

‡ *The Times*, February 15, 1896.

"(*a*) Number in favour of combination exceedingly few, and no apparent desire to alter present system of dealing with their produce.

"(*b*) More than one half of those seen showed absolute indifference in the matter, except that some have taken the opportunity to ask for lower rates with present conditions.

"(*c*) To a large extent the traffic is already provided for by low rates, as to which no complaint was made.

"(*d*) Much of the produce, as might be expected, is taken by road to the neighbouring market towns.

"(*e*) A considerable part is bought by middlemen who visit the districts, and pay the railway charges.

"(*f*) Generally, there does not appear to be any really acute depression in the farming industry in the London and North-Western districts, and most of the farmers did not seem to look upon reduced railway rates as a cure for any depression there might be."

In spite of rates alleged to be almost prohibitive there appeared to be a large and increasing home fresh-meat traffic from Scotland, Cumberland, Westmoreland, and other parts to the Metropolis.

As an instance of what intelligent combination and organised effort may effect, we may note that within a dozen years Denmark has increased her annual export of eggs to Great Britain from 60 to 200 millions, mainly through the agency of a Co-operative Association consisting of 14,000 members, each one of whom is a producer. It includes 200 branches, which undertake the work of collecting, grading, stamping, packing, and shipping.

Whether the fault lies with the railway rates, with the farmer, or with the lack of light railways, the English markets are more and more, year by year, flooded with foreign produce. A Royal Commission on Agriculture was appointed by Mr Gladstone in 1893. The increase of foreign competition during the last twenty years, the consequent fall in prices, and the cost of production, are dealt with in the Report, which was not issued until August 1897. The *Agricultural Returns for Great Britain, etc.*, for 1895, also afford ample information for gauging the depth of our agricultural depression.

In twenty years (1875–1895) the loss of arable area has been 2,137,000 acres. The reduction in wheat-growing—from 3,343,000 to 1,418,000 acres—is mainly responsible for this. In twenty-five years (1866–70 to 1891–95) the price of wheat has declined from 54s. 8d. to 27s. 11d. per quarter. Most of our wheat comes from the United States (which cultivates 34,880,000 acres), Russia (32,860,000 acres), India (26,030,000 acres), and Argentina; wheat flour is exported to us from the United States mainly, but Canada, Austria, and France also send us a good deal. The yields of wheat crop per acre vary considerably—13 bushels in America, 11 in Russia, 9 in India, 19½ in France, and 26⅓ in the United Kingdom. The following figures will show how enormous our grain imports of all kinds are, and which countries supply most of it:—

QUANTITIES of Wheat, Wheat Flour, Barley, Oats, and Maize imported into the United Kingdom from certain Countries in 1894.

Countries from which Exported.		Wheat Grain.	Wheat Flour.	Barley.	Oats.	Maize.
		cwts.	cwts.	cwts.	cwts.	cwts.
Total, ...		70,126,232	19,134,605	31,241,384	14,979,214	35,365,043
Foreign Countries.	Argentina, . .	13,272,152	8,435	...	...	...
	Austrian Territories,	...	1,106,971	...	...	...
	Chili, . . .	1,764,612	1,600	...	...	...
	Roumania, . .	...	...	3,020,182	...	14,167,972
	Russia, Northern, .	52,277	9,186	262,567	11,541,807	...
	Russia, Southern, .	16,723,604	24,215	19,184,553	915,099	8,648,416
	Turkey, . .	...	...	2,972,697	...	954,311
	U.S. of America Atlantic,	15,773,828	15,378,304	7,605	...	9,534,487
	U.S. of America Pacific, .	8,884,417	547,182	1,507,146	...	36,575
British Possessions.	Australia, . .	3,651,275	52,972	...	...	...
	Canada, . .	2,828,515	1,195,421	...	...	779,495
	India, Bengal, .	280,012	...	...	...	...
	" Bombay, .	5,069,044	10,579	...	...	...

The rye imports, mainly from Russia, amounted to 1,009,226 cwts. Of 134,893 cwts. of buckwheat, France sent us more than half, and Russia about a quarter. Beans reach us from Egypt, Morocco, and Turkey, and peas from Canada, Russia, the United States, and India.

Live cattle and live sheep are exported to us from the United States, Canada, and Argentina. Of imported cattle the number received in the Metropolitan and Foreign Cattle Markets in 1895 was about the same as in 1875; of imported sheep the number was less than half. In 1895 we kept more cattle, more pigs, and fewer sheep than we did in 1875, but the differences are not striking, and we may almost regard the home stock as stationary. Meanwhile, there has been a rapid increase of population, and the increased demand for meat has been met by the development of the frozen-carcase trade, started in 1882. We imported 10,610,394 cwts. of dead meat in 1894, of which the United States sent us 6,136,597 cwts., New Zealand 1,003,318 cwts., and Australia 977,788 cwts., Denmark, Argentina, Holland, and Canada also contributing. Fresh beef imports amounted to 2,104,104 cwts., of which the United States supplied 1,775,538 cwts., and Australia 301,896 cwts. Fresh mutton imports amounted to 2,295,066 cwts., New Zealand sending us 971,072 cwts., Argentina 585,729 cwts., and Australia 468,430 cwts. Bacon and hams form a large proportion of the dead meat imported from the United States, which sent us 2,561,203 cwts. out of 3,689,604 cwts. in 1894, while Denmark and Canada sent much smaller quantities.

While the price of imported butter has been generally maintained during the last ten years, being about £5 per cwt., the quantity has increased between 1890 and 1895 by about 40 per cent., and more than 40 per cent. of it comes from Denmark. In 1895 we received 2,825,682 cwts. of butter from abroad, and 1,109,325 cwts. of margarine, nearly all from Holland.

The value of our imports of rabbits, poultry, game, eggs, and lard has increased from £4,522,673 in 1875 to £7,866,132 in 1895. The value of the egg imports touches four millions sterling. Of 1,425,236 thousands of eggs, more than one-fourth were supplied by Russia through Germany. Italy—through France—and Belgium were also large contributors.

We imported 17,383,774 bushels of raw fruit in 1894. Spain sends us oranges; Belgium, apples and pears; France, apples, pears, plums, and cherries; the United States, apples; Italy, lemons and oranges; Holland, apples, pears, and plums; and Canada, apples. The value of raw vegetables imported in 1891–94 averaged £2,801,686. Of 2,703,803 cwts. of potatoes imported, the Channel Islands (and this is not so unsatisfactory) sent us 1,139,542 cwts., France being also a large contributor. The extended cultivation of small fruit in Kent, Middlesex, and Worcestershire is encouraging, however, with the increased acreage of market gardens in Great Britain, from 38,957 in 1875 to 59,473 in 1885, and 92,837 in 1895. In nursery grounds there has been a slight increase, from 12,042 acres in 1875 to 13,290 in 1895. Orchards in 1895 covered 218,428 acres, as compared with 154,584 acres in 1875.

Report of Royal Commission on Agriculture.—It is reported by the Royal Commission on Agriculture that, as regards meat, foreign competition has been more severe, probably, in pork—*i.e.*, bacon and hams, mainly—than in other classes, but that no actual displacement of the home produce can be traced. More than half the total quantity of butter, margarine, and cheese which we consume is imported; while nearly three-fourths of the total amount of wheat needed annually for consumption in this country comes from abroad.

The price of wheat has fallen 50 per cent.; that of beef, 24 to 30 per cent.; mutton, 20 to 30 per cent.; wool, 50 per cent.; and dairy produce, milk, cheese, and butter, 30 per cent.

Of the three classes of the community most intimately connected with agriculture—landlords, tenants, and labourers—the last do not appear to suffer at all ; in fact, with wages undiminished and cheaper bread-stuffs, the position of the farm-labourer was never better than at the present moment. Landowners, however, have had to submit to heavy reductions of rental; in some cases they can get no rent at all and the farms are thrown on their hands; not infrequently they have to pay the tithe without any adjustment of rental; and they have had to bear increased expenditure on repairs, drainage, and buildings. It is estimated that the value of agricultural land has fallen by as much as £1,000,000,000. Land has been largely withdrawn from the plough; sometimes it has been degraded to the condition of rough pasturage; in other cases it has been allowed to become wholly derelict. The depression is, of course, most evident in the arable counties; but, on the other hand, there is actually considerable competition for farms in the south-west of Scotland and in Wales.

Yeomen-proprietors have suffered very severely. Tenant farmers have, perhaps, suffered somewhat less than the landowners. Stock-breeders and graziers have been doing better lately. Dairy-farmers, fruit-growers, and market-gardeners appear to have done better than the rest. For the majority of farmers, however, there seems to be little hope of relief, to enable them to fight against falling prices, from above or from below, for their wage-bills are bigger than ever, and their rents have reached the minimum.

Among the recommendations formulated by the Commission are—increased security of tenure to farmers, and full compensation to them for improvements; the adjustment—by agreement, not by the action of land-courts—of rents to the farmers' returns; the relief of farmers from harassing restrictions in regard to cropping, and protection against damages arising from excessive game preservation; the encouragement of scientific methods of farming, and the control of technical agricultural education by the Board of Agriculture; the registration of dealers in foreign meat and its advertisement as such; the advance of public money to landowners to enable them to improve their estates for profitable occupation by tenants, etc. Mr Channing differs from the other members of the Commission in considering an alteration of the land-tenure laws the first step to be taken towards recovery, while ten of the Commissioners regard bimetallism as the most potent remedy. Further reductions of railway rates would, in the opinion of the Commissioners, do much to help the farmer. That the railways are willing to afford relief in that direction so far as possible we have already seen, but, in order to avail himself of it, the farmer must follow the example of the foreigner and the colonial, and enforce—not sink—his strong Anglo-Saxon individuality in intelligent combination.

But especially it must be borne in mind that, while Mr Grierson was able, some years ago, to point out that in England, branch lines of railway had been carried into sparsely populated districts to an extent unknown in France, Belgium, or Holland, the position in this respect is practically reversed to-day. We were better off than our neighbours* when we had better railway communication than they. But now an increasing stream of wine, maize, oil, eggs, poultry, chestnuts, etc., flows from Italy through the St Gothard tunnel and France to England, so that the Lombard peasant can actually undersell the British farmer in the London market. That the foreign producer has found in light railways most powerful allies, cannot be denied. "To compete with foreign producers," was the avowed object of the Belgian light railways. But the development of minor railway communications in Great Britain has been arrested by obstructions which no small project could successfully overcome. It has been necessary for every railway to face most costly investigations before Private Bill Committees of first one and then the other House of Parliament, and to satisfy the demands of opposing interests, before an Act could be obtained authorising the construction and working of the line. Then the regulations of the Board of Trade were applied as rigorously to a small and poor line as to a great system with an enormous traffic, so that—as the Hon. Secretary and Manager of the Easingwold Railway observed†—far from encouraging small lines in the interest of agriculture, "Parliament and the Board of Trade block the way instead of clearing it." In the matter of rates, no better terms were conceded to the branch than to the long-lead main line. Thus it is that, unless he owns a cart, the villager must either depend upon his own legs, or await the coming of the carrier, to take him to the nearest market-town, and the want of an efficient means of carriage has thrown the British producer more and more into the background. The repressive effect of this isolation upon the energies of the agricultural population need not be dwelt upon. It would almost seem that they could place no confidence in any scheme for their relief, and it was rather through the continued efforts of those who had studied the advantages secured in other countries by the development of cheap lines, than in response to any determined demand from the British agriculturist, that the Light Railways Act of 1896 was passed. The relief afforded by this measure may be briefly summarised. It is not now necessary to obtain a special Act for the construction of a light railway. Enquiries are held locally by the Light Railway Commissioners, and also by the Board of Trade, if the latter think fit. Light railways may be more leniently treated in details of permanent way, gauge, fencing, the crossing of public roads on the level (instead of by means of overbridges or underbridges), block signals, brake power, station requirements, etc. The track may be laid on a public road, if required. Local authorities—the council of any county, borough, or district, through any part of which the proposed railway is to pass—may be authorised to construct and work a light railway, and they may make advances to light railway companies, either by way of loan or as part of the share capital. Land may be compulsorily acquired under the Arbitration Act of 1889 without recourse to Parliament, and "betterment" will be duly considered in fixing compensation. The Treasury may afford assistance under certain conditions.

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* *The Times*, March 7, 1894.

† *Journal of the Society of Arts*, Feb. 15, 1895; Acworth on "Light Railways."

The application of the Act is still in the experimental stage. Its introduction was largely due to the examples of light railway development afforded to us by other nations, and this has been, perhaps, most striking and most successful in Belgium, to which the following chapter will be devoted.

CHAPTER III.

LIGHT RAILWAYS IN BELGIUM.

CONTENTS.—Early railway enterprise—Belgian railways the medium for international traffic—Light railways required for internal traffic—Formation of the "Société Nationale de Chemins de Fer Vicinaux" in 1885—Provision of capital—Division of profits—Constitution of the Society—Procedure for obtaining concessions—A metre-gauge system of local railways on roads—Permanent way—Locomotive engines—Passenger carriages—Quantity and cost of rolling-stock—Working of the lines leased—Determination of working subsidy by formulæ—M. de Burlet's review of various formulæ—Rates and fares—Major Addison's report on Belgian light railways—Brakes—Cost of Belgian light railways and Indian lines compared—Comparison of revenue and expenditure impracticable—Financial results of Belgian light railways—General and indirect benefits—The Society's views on population and wealth as *criteria* of the desirability of light railways—Belgian railways initiated by King Leopold—State ownership of Belgian railways—State aid and control of Belgian light railways—Successful association of Government monopoly and private enterprise.

Railway Systems.—Belgium—which presents to us to-day the most complete system of light railway organisation—was the first of Continental nations to follow the lead of England in the early days of railway construction, for which, however, the country offered no particular facilities. North and west, the surface lies low and very level, but it is intersected with canals and rivers requiring a good deal of bridging; while to the south and south-east—rich in quarries of stone and mines of coal, iron, and zinc—the ground is exceptionally rugged and broken, and the engineering work was heavy. As a matter of fact, the railways of Belgium have cost about as much (£26,611 a mile) as those of France (£27,375 a mile). Yet, at the end of 1894, the mileage of railways open in Belgium, the United Kingdom, France, and Germany respectively was 29·1, 16·6, 11·5, and 13·6 per 100 square miles, and 5·4, 5·3, 6·4, and 5·5 per 10,000 inhabitants. But, although the natural difficulties were such as demanded comparatively high expenditure, Belgium occupied a good intermediate position between two interchanging countries; and the energetic policy, which soon covered the country with railways, was stimulated by jealousy of Holland, which had hitherto secured, through the Rhine, most of the traffic between Germany and England. Railway communication was established between the ports of Ostend and Antwerp on the north and the frontiers of France and

Prussia on the south and east. The main lines were planned and executed by the Belgian Government, and, where the State did not care to take matters into its own hands, private companies were allowed to complete the branches and connections. The mineral and manufacturing wealth of the country grew apace, and Belgium, instead of the Rhine and Holland, furnished, through her railways, the most direct trade route between Central Europe and England.

Not only did the State originate and construct the main lines, but it has continued to work them; and even those which had been conceded to private companies have nearly all reverted to State management. The whole of the national system is under the direction of the Minister of Railways.

Thus, in main lines of railway—as well as in roads and navigable canals and rivers—Belgium was well supplied. It still remained to complete minor lines of internal communication by means of light railways; and in 1885, when agriculture and trade were in a state of serious depression, the "Société Nationale de Chemins de Fer Vicinaux" was formed with the object of building "light railways or steam tramways along existing roads, and with a narrow-gauge, which would admit of cheaper materials in the construction of the lines, and less expensive rolling-stock; would thereby insure the greatest economy; and, through the consequently reduced rates, would enable agriculturists and others to convey the produce of their labour to local markets, and also to compete with foreign producers." This, of course, very much describes the hopes of those who have pressed forward the claims of light railways in England.

Mode of Providing and Working Local Light Railways.—The "National Society (or Company) for Local Railways" forms the common link between the State, the Provinces, the Communes, and, to a very limited extent, private enterprise. Dealing with lines of purely local interest, it keeps the capital and accounts of each line separately, but the direction of the whole system is centralised in one administration. By Royal Decree, the Society has the absolute monopoly of constructing such lines as local authorities desire; and only in case of the Society not caring to take advantage of its right of preference within a certain period can any other company or individual obtain a similar concession. The Society and its lines are, as far as possible, relieved from payment of dues, rates, and taxes.

The Society determines, after consideration of a particular project, the capital to be subscribed. Of this at least two-thirds must be subscribed by the State, the Provinces, or the Communes; but, as a matter of fact, private individuals do not largely avail themselves of the privilege, especially reserved to them, of subscribing the remaining third of the capital. Although the State is legally empowered to subscribe as much as half the capital, it is usual to limit the Government subscription to one-quarter; and the Provincial and Communal Authorities are expected to raise the remaining three-quarters, the intention being that the Communes should be the largest subscribers, as it is in their interests mainly that the light railway movement was projected. No limit is prescribed for the contributions of the Provinces and the Communes, but those of private individuals must not exceed one-third of the capital of such line. After the ninetieth year of working has expired, the State, the Provinces, and the Communes concerned may buy out the private shareholders at par rate.

Instead of advancing the whole amount of their contribution at once, the State, the Provinces, and (if they can show sufficient security) the Communes may furnish their subscriptions in the form of contingent annuities, spread over a period of ninety years, and calculated at 3½ per cent., interest and amount paid off included. The Society, moreover, may issue debenture bonds representing the annuities due to it.

Of £2,349,760, the amount subscribed up to the end of 1893, the State had advanced £635,840, the Provinces £658,080, the Communes £960,160, and private individuals £95,680. This comes to 27 per cent. from the State, 28 from the Provinces, 40·9 from the Communes, and 4·1 from private individuals.

After meeting the cost of maintenance and working, the profits of each line go, first of all, to paying off the annual subscriptions of the public shareholders, and the payment of a first dividend to the holders of paid-up shares—*i.e.*, to private individuals, the dividends not to exceed 4½ per cent. If the profits are not enough to cover these first charges, the resulting balance is distributed *pro ratâ* to both private and public shareholders, so that all may be treated alike.

After the above payments have been made, and the administrators and Director-General have received their commissions, any surplus remaining is divided in the proportion of—

(1) One-quarter to form a fund for extending and improving the line.

(2) Three-eighths as a second dividend to the shareholders; and

(3) Three-eighths to the National Society, by way of a reserve fund to cover losses, and to extend and improve the whole system of light railways.

The reserve fund of each line may now be drawn upon for the declaration of dividends, but only with the authorization of the Government.

An example of such a distribution of the profits of the Antwerp-Turnhout light line at the end of 1893 is here quoted from Mr G. Cary-Elwes' report (*Reports from Her Majesty's Representatives Abroad on Light Railways*, 1894):

Net Profits, ...	£4613
Interest on Capital available, ...	5
Total amount to be divided, ...	£4618

First Dividend—	
Annual Subscribers, at 3½ per cent.,	£2687
Holders of paid-up Shares, at 4½ per cent.,	412
Charges* to Administrative Council and Director-General,	212
Improvement Fund,	327
Second Dividend—	
Annual Subscribers, at ½ per cent.,	438
Holders of paid-up Shares, at ½ per cent.,	52
Reserve Fund,	490
	£4618

In this case the annual subscribers—the State, the Provinces, and the Communes—had their 3½ per cent. subscription for the year paid back to them in the first dividend, and received an additional ½ per cent. in the second dividend; while private individuals received their full 4½ per cent. in the first dividend, and a bonus of ½ per cent. in the second dividend.

If the working expenses of a line exceed the receipts, the deficit is made good by the National Society from the general reserve fund, subject to recovery from subsequent profits of the line; and, so far, the resources of the Society have never, on this account, been overstrained. On the other hand, if the receipts do not cover the working expenses for three consecutive years, or even if, for five consecutive years, the profits are less than half the interest charges on the first cost capital, the National Society has the power of closing the line to traffic and debiting the loss to the reserve fund. As a matter of fact, the net earnings cover more than four-fifths of the interest charges at 3½ per cent. on the capital expended by the Society on the lines worked.

The National Society is under the administration of a Council or Board composed of a President or Chairman, four (or, if Government require, six) members or directors, and a Director-General or Managing Director. The Council has considerable powers.

According to their attendances, the President and members receive annually from £600 to £1200, and they have also a right to commissions at 2 per cent. (subject to a maximum of £400 each) after payment of the first dividend to the shareholders. The Director-General receives a fixed salary, *plus* commissions at the rate of 4 per cent. (but subject also to a maximum of £400). It is his duty to see that the decisions of the Council are carried out, and to direct generally the business of the Society.

Then there is the "Comité de Surveillance," or Supervisional Committee, of six members, annually nominated, who draw salaries fixed (according to their attendance at meetings) by the General Assembly. It is their business to check the audit of accounts and stock-taking,

* Calculated on the net profits, exclusive of the interest on capital available.

to inspect all the lines in turn, and generally to look into the affairs of the Society.

Finally, the General Assembly is composed of shareholders, members of the Council and of the Supervisional Committee, and the Director-General. Each Province and Commune is represented by a delegate. Each share carries a vote, but no one may vote in respect of more than one-fifth of the total number of shares issued, or two-fifths of the shares represented at the Assembly. The meetings are annual, but extraordinary meetings may be summoned by the Council, if demanded by the Supervisional Committee or by shareholders representing one-fifth of the capital of the Society.

A month later in the same year, 1885, another Royal Decree was issued, prescribing the procedure for obtaining a concession to construct a local railway.

Formal application is made by the National Society to the Department of Agriculture, Industry, and Public Works. With the application are to be submitted—a report, a detailed estimate, the proposed rates and an estimate of the probable receipts, a specification of the project, a copy of the Government map (scale $\frac{1}{20.000}$) of that part of the country through which the line is to run, a general plan (scale $\frac{1}{2500}$) showing the line and sidings, a special plan (to a scale of $\frac{1}{200}$) of ground occupied by houses, a longitudinal section and, so far as they are required, cross sections, and detailed drawings of particular works and the type of permanent way adopted.

After preliminary examination (and, if necessary, an enquiry) by the Department, the papers are made available for inspection by the public in the town hall of each Commune for fifteen days, in order that objections and criticisms may be recorded. These, with the opinions of the Communal Councils interested, are passed on to the Provincial Councils, and by them, with remarks, are once more submitted to the Department for final consideration and, if necessary, further enquiry. The Department may make such modifications as appear advisable in the drawings and specification of the project and the concessions to be granted, and the proposal then only requires the signature of the King.

The compulsory acquisition of land may be provided for, if necessary.

The aim of the Society has been, of course, to construct their lines as cheaply as possible, and to lay them, where practicable, on existing roads. The cost has been, as a rule, less than £3000 a mile; perhaps £2700 may be taken as a representative figure. In regard to gauge, as much as 655 miles had, at the beginning of 1896, been laid to the gauge of 1 metre (3′ 3⅜″); 148 miles to the gauge of 1·067 metre (3′ 6″) in view of possible connections with the Dutch vicinal lines; and 40 miles to standard gauge (4′8½″), where it was desirable to avoid transhipment of goods to or from the main lines. Practically, it is a metre-gauge system.

The intention is, so far as possible, to lay the way on the sides of existing roads. In that case, the permanent way* costs as much as £977 per mile, as against £793 on independent formation; laid in paving it is still more expensive, of course, rising in price from £1108 to £2266 per mile, according to the pattern adopted. On roads, a 43·25lb. flat-footed steel rail rests on iron bearing plates, through which dog-spikes are driven to fasten the rail to creosoted oak-sleepers (5′ 11″ long, 8″ wide, and 4″ deep, about the same dimensions as our Indian metre-gauge sleepers), packed in gravel, stone or (more usually and economically) cinder ballast, 8″ deep under the sleeper. There are ten sleepers to a 29′ 6¼″ rail, the space between the joint or guard sleepers being 1′ 9″, the next interval 2′ 10½″, and the rest 3′ 1¾″. It will be noticed that the guard sleepers on either side of the joint are set much closer together than is usual with us. The fish-plates have an angle-section, and are 17″ long. This is the general type of metre-gauge permanent way. The limiting radius of curves, outside towns, is 246 feet. The railway is marked off from the rest of the road by a raised border or row of kerbstones, a somewhat expensive item; the line of these is broken at intervals to afford outlets for open cross drains. Curves being often very sharp, especially in towns and factories, the National Society has made a special study of them, and laid down particular rules in regard to the super-elevation or cant, and the setting-out of parabolic curves. It is obviously better in the case of road-railways to obtain the requisite cant by lowering the inner, as well as by raising the outer, rail, so that the centre line of the track may keep the road-grade. The usual formula—

$$E = \frac{G\ V^2}{g\ R}$$

has been adopted by the Society, where G = gauge, V = maximum velocity, g = accelerative force of gravity per second, and R = radius of curve. The maximum speed is 18·6 miles per hour in the country, and 6·2 miles per hour in towns. The latter speed requires a very small cant indeed, even with sharp curves. Slack gauge varies from ⅛ of an inch for curves of 150 feet radius to ⅜ of an inch for 100 feet curves, the allowance being fixed for the type of locomotive used. With a 47·3lb. rail only eight sleepers are prescribed per bay of rail-length of 29′ 6½″. In the neighbourhood of their manufacture, double Z-sectioned metal sleepers are used, each pair holding between them a shoe bolted to them, and the lower flange of the rail being gripped by one lug of the chair, and keyed up under the other. As we find in India, the first cost of metal sleepers is heavy, but they last well.

In passing through towns, a heavier rail—66lb. flat-footed—is used, laid flush with the road-paving. In this case, as shewn in the figures, either a guard-rail (which also acts as a fish-plate) is bolted to it, or a wooden kerb is held up to the rail by a hook-plate of hammered iron passing under the rail (which has not to be drilled). This does not interfere, therefore, with ordinary cart and carriage traffic. The railway has to maintain the pavement between the rails, and a strip twenty-four inches wide on each side. The roadway is not only paved in towns, but also in such exceptional places as level crossings, entrances to private works, etc., in the country. For fuller particulars of the per-

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* *The Engineer*, April 10, 1896.

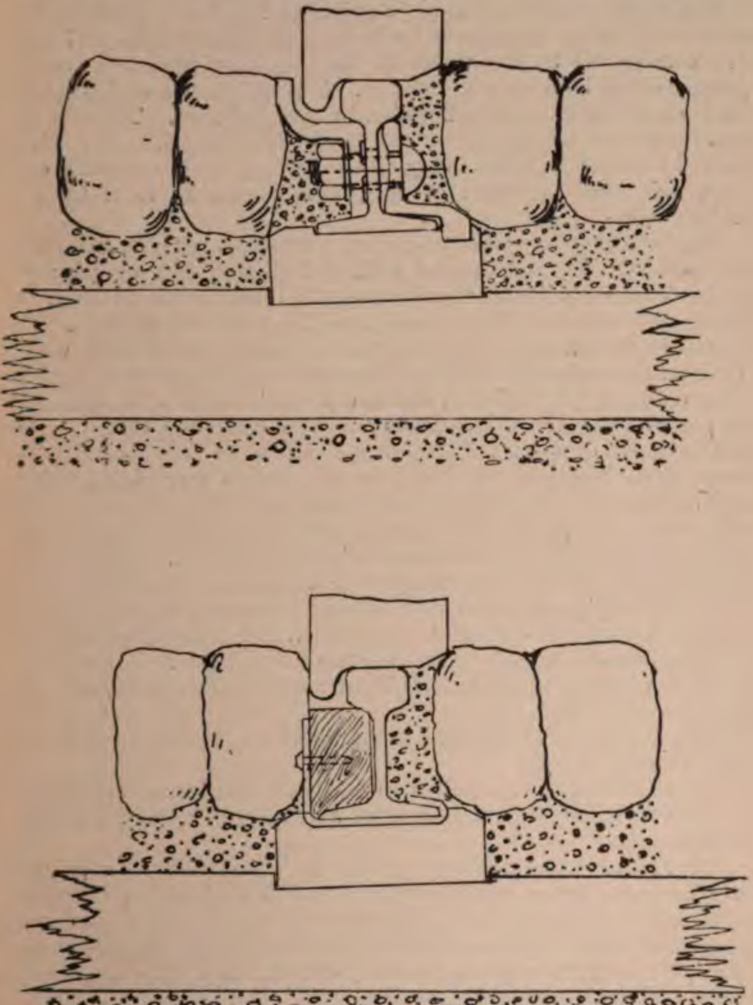

Fig. 1.—Permanent-way, Belgian Light Railways.
Mode of fixing rails in streets of towns.

manent-way as well as of the rolling-stock, the reader is referred to *The Engineer* for April 10th, and May 1st, 1896, and to *The Railway World*, June 1896.

For general service locomotives weighing 15½ tons in full working order, and for heavy goods trains those of the type weighing 27 tons, are commended by the writer in *The Engineer*, who made several journeys with both classes of engine. The wheels are ordinarily six-coupled, with a diameter of 2′ 8¾″ and a base of 5′ 10⅞″. The cylinders and frames are outside the wheels, to steady the engine as much as possible. Coke is burned only in the towns; in the country coal-dust briquettes are used as fuel, but the smoke from them is objectionable.

The bodies of the passenger-carriages are built of teak, lined with pitch-pine inside, and covered with $\frac{3}{64}$ inch sheet-iron outside; the under-frames are iron; the flanges of the wheels are of steel, the naves and spokes of forged iron, and the axles are of steel. The seats of the second-class carriages are arranged transversely, with a clear passage down the middle of the carriage. The seats of the first-class carriages are cushioned, and in one compartment of each a couch is placed along the side. There are also composite carriages, one compartment of which is first-class and the other second-class. The doors are at the ends of the cars, and open on to a platform, such as our carriages in India are frequently provided with. The total length of frame is 22′ 3¾″, the width over all of the body of the car 7′ 11″, and the central height of the car 9′ 6″ above rail level. The diameter of wheels is 1′ 11⅝″, and there are four wheels to a car, with a wheel-base of 7′ 10½″. A first-class or a composite carriage weighs 4 tons 10 cwt., a second-class carriage 4 tons 8 cwt., and a luggage-van (which is built as nearly as possible on the same lines) 5 tons. The cost of a first-class or of a composite is £152, of a second-class £130, and of a luggage-van, £120.

The rolling-stock is supplied to the working companies or lessees by the National Society.

There were 253 locomotives in service, most of them weighing 18 tons; but, besides lighter ones, there were some weighing 22, 24, 27½, and 30 tons.

Of 716 passenger vehicles in use—10 closed and 10 open were for horse traction; 116 were first-class, 399 second-class, 128 mixed first- and second-class, and 21 mixed carriages with luggage and goods compartments; they included also 32 bogies, of which 10 were second-class, 8 mixed first- and second-class, and 14 mixed first-class, second-class, and goods compartments.

There were 140 luggage vans; 76 covered goods wagons (5 tons); 188 covered goods wagons (10 tons); 128 high-sided wagons (5 tons); 1018 high-sided wagons (10 tons); 70 flat wagons (5 tons); 151 flat wagons (10 tons); 3 special trucks; 3 cranes; and 3 cisterns.

The cost of the rolling-stock averages 9813 francs per kilometre or about £632 per mile. There are approximately 1 engine per 3 miles, 1 passenger carriage per 1 mile, 1 luggage van per 5½ miles, and 1 goods wagon per ½ mile of main line.

It is not the practice of the Society to work the lines itself, but to lease them out to working companies, and so to afford a field for private enterprise. The lessees may be individuals, companies, or—in some instances—associations formed by the local authorities. As in France, however, so in Belgium the difficulty has been to establish satisfactory agreements for working lines of poor traffic. In both countries the subsidy was determined by a formula which gave the working agency a certain proportion of the gross receipts, and, so long as the agency could secure its remuneration from goods bearing comparatively high rates, it had no further interest in the development of larger and more important traffic, which could only bear very low rates.

Moreover, the Belgian National Society, like the French Departments, found it advisable to reap the full benefit of its own credit by providing the whole of the capital, and only leasing out the working of the lines. It even equips them with rolling-stock in order to avoid the payment of interest on outside capital on this account. But it demanded an altogether inadequate security of 2000 francs per kilometre, or £129 per mile from the lessees, which left it at the mercy of the latter, if they chose to sacrifice that amount and throw up the contract rather than face heavy and sudden expenditure on renewals of way and stock. Considerable modifications have accordingly been made in the terms of lease, and those now in force are described by M. de Burlet (General Manager of the Society) in the *Bulletin de la Commission Internationale du Congrés des Chemins de Fer*, vol. ix., 1895, from which is derived the following information:—

So far as possible, connected lines are grouped under one working company. The lines are worked on a thirty years' agreement, terminable, however, at the end of fifteen years on twelve months' notice by either side; but the liability to closure at the end of a shorter period tends so much to limit the interest of the lessee in the line that this clause is usually omitted.

The National Society leases the line and all appurtenances thereof (except furniture, instruments, tools, etc.), and also the rolling-stock. As a rule, too, it supplies additional rolling-stock required; and, whether it does so or not, the design must be such as it approves.

As we noticed above, the security of £129 per mile was found to be inadequate; and it has, accordingly, been increased by the institution of a renewal fund to which the lessee must contribute £19½ per mile, and by a charge of £160 per locomotive, of £16 per passenger carriage or luggage-van, and of £6 per goods wagon, placed at the disposal of the working company. The cost of insuring buildings and rolling-stock falls also upon the working company.

The Society controls and supervises all works of maintenance and alterations.

Monthly returns are submitted to the Society for audit of the receipts under each class, and separate division sheets of earnings, showing the proportions due to the working company and to the National Society.

The minimum number of trains is generally as many as five in each direction; and the Society may call for an increase in the number of trains when the gross receipts per mensem average more than 1s. 11d. per train-mile.

The rates are scheduled in the Act, but the National Society may alter them with the sanction of the Government.

To make up for possible lack of enterprise on the part of the working company, the National Society has organised a special traffic staff to study the peculiar requirements of the trade, manufactures, and industries of the country; to consider complaints and claims; to conciliate the interests of both lessees and the public in the matter of rates; and to attract and foster traffic in every way.

The location of stations, stopping places, private junctions, etc., is fixed by the National Society.

The Belgian formulæ of division are the following:—

$$\left.\begin{array}{l} F = 1500f + pR \\ L = £97 \quad + pR \end{array}\right\} \cdots\cdots\cdots\cdots (1)$$

where F = working subsidy, in francs per kilometre, R = gross receipts in francs per kilometre, and p averages 0·30; L and R, in the second equation, expressing the working subsidy and gross receipts in pounds sterling per mile. This formula has been abandoned.

$$\left.\begin{array}{l} F = pR \\ L = pR \end{array}\right\} \cdots\cdots\cdots\cdots (2)$$

where p averages about 0·60, and the working subsidy is subject to a minimum of 2000 francs per kilometre or £129 per mile. This is considered by M. de Burlet to be the best formula for the more prosperous lines.

$$\left.\begin{array}{l} F = 1900f + p(R - 1900f) \\ L = £122 \quad + p(R - £122) \end{array}\right\} \cdots\cdots\cdots\cdots (3)$$

where p averages about 0·25. This formula is only applied to a few lines.

$$\left.\begin{array}{l} F \\ L \end{array}\right\} = C + 0{\cdot}50\ (R - C) \cdots\cdots\cdots\cdots (4)$$

where C may be 1000, 1300, or 1500 francs per kilometre, and £64, £84, or £97 per mile. Tenders for working the lines are considered with reference to the particular value assigned to C. This formula is, in M. de Burlet's opinion, admirably adapted to lines of poor traffic. It gives the lessee better terms, when the receipts are low, than formula 2.

In order to show roughly the comparative effect of the application of these formulæ, it will be sufficient, perhaps, to quote only three lines of M. de Burlet's table, and to give the English equivalents.

Gross Receipts.	(1) 1500 + 0·30R.		(2) 0·60R.		(3) 1900 + 0·30 (R − 1900).		(4) 1300 + 0·50 (R − 1300).	
	Owner.	Lessee.	Owner.	Lessee.	Owner.	Lessee.	Owner.	Lessee.
Francs per kilometre.	*f.*	*f.*	*f.*	*f.*	*f.*	*f.*	*f.*	*f.*
1500	−450	1950	600	900	...	1500	100	1400
3750	1125	2625	1500	2250	1295	2455	1225	2525
6000	2700	3300	2400	3600	2870	3130	2350	3650
Pounds per mile.	£	£	£	£	£	£	£	£
97	−29	126	39	58	...	97	6	91
241	72	169	97	144	83	158	79	162
386	174	212	154	232	185	201	151	235

M. de Burlet draws attention to the special case where running powers are given (an intermediate third rail being laid to smaller gauge) by the State Railways to the Coastal Light Railway over a certain length (less than two miles) of State line into Nieuport. The whole of the gross receipts over this short section goes to the State Railway Administration which built the line; but the National Society, for providing engines, train-staff, booking-clerks, etc., receives six francs per train-kilometre, or 7s. 8·69d. per mile. The light railway connects certain watering-places between Ostend and Nieuport; and at the latter end, during the season, eleven trains belonging to the State Railways and eight of the Light Railway run in each direction over the joint three-rail section, carrying passengers to and from the beach.

The following information, regarding rates and fares, is quoted from Mr Gervase Cary-Elwes' report* :—

"The charges for the carriage of goods come under two heads: (1) carriage by fast trains; and (2) carriage by slow trains. The tariff for fast trains is based on the following rates:—

"1. A fixed rate for all distances, per 2 cwt., 6¾d.

"2. A variable rate per half-mile, per 2 cwt., ¼d.

"These rates include charge for loading and unloading, registration, etc.

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* *Commercial. No.* 9 (1894). *Reports from Her Majesty's Representatives Abroad on Light Railways*, pp. 13–15.

"The tariffs for slow trains are divided into:—

"*Class I. (for Goods weighing less than* 5 *tons).*

1. A fixed rate for all distances	5d. per ton.
2. Loading and unloading	10d. ,,
3. A variable rate per ½ mile	1¾d. ,,

A charge of 3d. is made per consignment for registration, etc.

"*Class II. (for Goods weighing* 5 *tons or over).*
Tariffs (A) and (B).

1. A fixed rate for all distances	5d. per ton.
2. A variable rate per ½ mile—	
Tariff (A), in covered trucks	1½d. ,,
Tariff (B), in open trucks	1¼d. ,,

"*Tariff (C) (for bulky Goods).*

1. A fixed rate for all distances	5d. ,,
2. A variable rate per ½ mile	1d. ,,

"Goods in Class II., Tariff (C), are sent in open trucks, without the Society being held responsible.

"In Class II., Tariffs (A), (B), and (C), a charge of 3d. is made per consignment, for registration, etc., as in Class I.

"In 1886, with the intention of aiding agriculture, the National Society established a special tariff for:—

"(*a*.) Lime, lime ash, mud from towns, limestone residue from sugar factories, to be used as manure.

"(*b*.) Residue from distilleries, to be used as provision for cattle.

"(*c*.) Cinders, slag, rubble from coal-pits, and quarry waste, to be used for improving roads; to be charged as follows:—

"1. A fixed rate, for all distances, per ton, 5d.

"2. A variable rate per half-mile, per ton, ½d.

"And a special tariff for—

"(*a*.) Chemical and artificial manure.

"(*b*.) Agricultural produce used as domestic provisions; to be charged according to Class I., with a minimum charge for 4 cwt., instead of 8 cwt.

"In 1888 a reduction was made in the rate charged for the transport of live animals, which resulted, in the following year, in a noticeable increase in that particular traffic, while in 1889 further reductions came into force for the transport of freestone, coal, beetroot pulp, and phosphates, and special rates were established for various products, such as wood for building, bark, cereals, potatoes, bricks, lime, and limestone for sugar works.

"Since then, up to the end of 1893, every year has seen the establishment of special tariffs, granting reductions for the transport of such products as straw, hay, flax, wool, cotton, tow, hemp, malt, tobacco, raw sugar, manure, raw salt, petroleum and vinegar in casks, nitrates, fresh vegetables, fruit, meat, sulphuric acid, and night soil (in special wagons). In many of these cases the variable rate per half-mile has been reduced from 1½d. and 1¼d. to 1d., from 1d. to ½d., and from ½d. to ¼d., while empty tins, casks, boxes, and baskets are now transported free of all charge.

"All the light railways are used for passenger traffic, as well as for the carriage of merchandise, and there is one line which is reserved entirely for passengers. There are first- and second-class carriages only, the general price of tickets being at the rate of ¾d. per half-mile, first-class, with a minimum of 2d., and a ½d. per half-mile, second-class, with a minimum of 1½d. On a few lines slightly higher rates are insisted on by the Government, to prevent competition with the ordinary railways. Luggage is carried at the rate of ¾d. per 2 cwt. per half-mile, with a minimum distance of 3 miles charged. 50 per cent. reduction, with a minimum distance of 9 miles, is allowed to members of schools and societies when travelling together, in which class are also included, for instance, members of circus companies. There are also season tickets for schoolboys, available for at least three months, at a reduction of 50 per cent. on twice the price of a single ticket, and since 1890 season tickets, allowing four journeys daily, have also been in use for schoolboys, enabling them to return home in the middle of the day, as well as after school hours in the evening.

"Weekly tickets for workmen are in use, varying, as to the rate of reduction in price, from 50 per cent. for distances from half-a-mile to 3 miles, to 60 per cent. for 5 miles, the reduction being on twice the price of a single ticket. In 1890, in order to induce market gardeners to give up walking to town, special rates were issued for them at less than ½d. per half-mile, and with 20 per cent. reduction on return tickets, and this new tariff met with great success the following year. In 1891 the National Society issued workmen's weekly tickets, available for a single journey each day, as in some cases the hours of the trains suited workmen going to their work but not returning therefrom, or *vice versâ*, and this was a popular and subsequently successful innovation.

"Policemen have free passes on the light railways, except when they are conducting a prisoner. Soldiers are allowed 50 per cent. reduction. Dogs have to be paid for at the same rate as second-class passengers.

"Ordinary return tickets are issued on most of the light railways at a reduction of 20 per cent., while in at least one instance 50 per cent. is allowed on market days, and on one line the agriculturist may take his produce in market trains free of charge. A twofold benefit results from these reductions, carried on as they are gradually, viz., a decided help and encouragement to agriculture, and ever steadily increasing receipts from both passenger and goods traffic."

On some lines owners are permitted to accompany their goods for market at very low fares, and this has increased such traffic considerably. A very good idea of the out-door working of Belgian light railways may be obtained from the report* of Major Addison, R.E. He inspected the line from Andense to Eghezée, which is 12½ miles long, and was intended to serve an agricultural district. The goods receipts amount to 60 per cent. of the gross earnings, and are the more important part of the traffic. The line generally follows the road, the permanent-way being laid on one side, and packed in ballast at a slightly higher level than the cart road, from which it is marked off by kerb-stones. The gauge is, as usual, 1 metre; the rails, of the Vignoles or flat-footed section, weigh 42 lbs. per yard, and are held down by dog-spikes to creosoted sleepers, measuring about 4′ 8″ long, 8″ wide, and 4″ deep. At road crossings, and in passing through villages, the tramway type of way is adopted. Points are worked by a lever in the country, and in towns by a key fitting a screw-head placed between the rails. One train in the day each way takes only 1 h. 5 m. to do the 12½ miles; the other trains make the journey in 1 h. 25 m. The engine is six-coupled, weighs 18 tons, and its wheels have a diameter of 3 feet. It may be driven from either side (the driver standing on whichever platform is in front); it is provided with hand screw-brakes; and all moving parts are cased. The engine is manned by a driver and a stoker. Where a loop is required, the running line is outside, in order that the carts may have access to the straight siding. The light line connects at Eghezée with the State Railway, but there is no actual junction of gauges. Persons riding or driving horses are warned, on the approach of trains, to keep at least 5 ft. clear of the rails, and, if they are not sure of the behaviour of their horses, they are to dismount and lead them until the train has passed. Level crossings, except in very few instances, are neither watched nor guarded in any way.

Most trains are mixed, the goods wagons being, as a measure of safety, placed between the engine and passenger carriages. This arrangement makes it impossible to warm the latter from the engine, so the pipes are heated from a small boiler placed on the front buffer-beam of the carriages.

On some lines screw-brakes, on others continuous brakes are used; in the latter case, engine, wagons and coaches are all fitted with them.†

For the financial results we shall first return to Mr Gervase Cary-Elwes' Report, above referred to. His figures bring us to the end of the year 1893.

Taking those railways only which had been working for at least one year (and compressing his figures), we find that the State subscribed £493,440, the Provinces £501,520, the Communes £730,920, and private individuals £89,000—total, £1,814,880. The rate of dividend received by the State was 2·79, dividends paid to the Provinces varied from 1·13 to 3·53, the Communes obtained a dividend of 2·73, and private individuals 3·88 per cent. Moreover, the average percentage of dividend has gradually increased, thus:—

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* *The Electrical Engineer*, January 4, 1895.

† Plocq. on "Brakes," *Bull. de la Comm. Internat. du Cong. des Ch. de Fer.*, vol. viii., 1894.

In 1890 it was 2·65
„ 1891 „ 2·75
„ 1892 „ 2·76
„ 1893 „ 2·80

The cost and capital of sixty-one of these lines, covering a total length of 726½ miles, may here be given as an example of the distribution of expenditure:—

INITIAL EXPENSES—	Total.	Per Mile.
1. General Expenses and Sundries,	£194,962	£268
2. Purchase of Land, . . .	158,620	218
3. Labour and Material, . .	982,064	1352
4. Buildings, ...	207,823	286
5. Rolling-Stock, ...	421,760	580
	£1,965,230	£2,706
Capital Subscribed, . .	£2,154,080	£2,967

Comparison of Belgian and Indian Light Railways.—We may, therefore, take £2700 per mile as roughly the cost of metre-gauge light lines in Belgium, and compare it with the cost of Indian lines on the same gauge. The Rajputana-Malwa Railway (see Table in Appendix IV.) cost Rx. 7604, or (taking Rx. = £0·6, for purpose of comparison) £4562 per mile; but then it occupies the position of a main line, it has to work up to the collar to cope with the heavy traffic offering, it requires now a 50lb. steel rail, and to be as well laid and well equipped as the broad-gauge standard lines, and it must not be regarded in any way as a light line. Let us rather take the figures furnished by the Company's section of the Rohilkund-Kumaon Railway, Rx. 3841, or £2304; by the Jodhpore Railway, Rx. 2004, or £1202 per mile; and by the Bickaneer Railway, Rx. 2229, or £1337 per mile. And, to make the comparison as useful as possible, let us take the cost in detail and re-group the headings, as nearly as may be, in accordance with those of the Belgian expenditure, as shown on the next page.

	Corresponding No. of Head (Belgian).	Rajputana-Malwa.		Rohilkund-Kumaon (Company's) Section.		Jodhpore.		Bickaneer.	
		Rx.	£	Rx.	£	Rx.	£	Rx.	£
Preliminary charges General charges	(1)	634	380	504	302	41	25	42	25
Land . . .	(2)	78	47	4	2	...	...	...	...
Formation . . Bridge work . . Fencing, etc. . . Electric Telegraph . Ballast and Permanent Way . .	(3)	4100	2460	2194	1316	1561	937	1803	1082
Stations and Buildings . . . Plant . . .	(4)	1237	742	407	244	131	78	162	97
Rolling-stock. .	(5)	1262	757	732	439	272	163	222	133
Loss by Exchange .	...	293 *	176 *	...	...	...	...	...	...
		7604	4562	3841	2304	2004	1202	2229	1337

* It is impossible to distribute this, but it mainly belongs to permanent-way and rolling-stock.

As the conditions in any two cases are never identical, and bare figures without some indication of the differences convey no particular information, the comparison will be attempted in greater detail.

In regard to "general expenses and sundries," there is no very great difference between the Belgian and the Rohilkund-Kumaon cost per mile. The expenses on the Jodhpore-Bickaneer Railway under this head cannot be compared with the others; there must be particular reasons for the phenomenally small amounts, and we shall not be far wrong in concluding that the survey was carried out under the orders of the State engineer, no part of his salary or of office expenses being debited to the railway, but only the pay of the small native staff actually in the field.

The native states of Jodhpore and Bickaneer built their railways on their own land, so there was no charge under this head. A considerable portion of the Rajputana-Malwa Railway runs through land granted by the native states; and, even in British territory—where, although the procedure of compulsory acquisition is simple, the official valuation is exceedingly liberal—the cost is so small as to make comparison with the cost of European land impossible.

The next head, "labour and material," includes the most expensive items of all. "Formation" and "bridge-work" cost little in the sandy Bickaneer Desert, not more than £83 per mile on the Jodhpore and £120 per mile on the Bickaneer Railway; but they were unavoidably heavy items on the Rajputana-Malwa line, £260 per mile for "formation" and £774 for "bridge-work."

It is in the matter of "permanent-way" that the greatest differences arise. In Belgium, as we have seen, the cost may be nearly £800 on independent formation (with which alone the Indian figures are fairly comparable), nearly £1000 per mile on the side of an existing roadway, and any amount per mile between £1108 and £2266 laid in paving, like a tramway. The Belgian metre-gauge rail, weighing 43½ lbs. per yard, compares fairly with the Indian metre-gauge rail weighing 41¼ lbs.; but, on the Rajputana-Malwa Railway, not only have renewals of the original 36 and 40 lb. iron rails been made, for many years, with 41¼ lb. steel rails, but the 400 odd miles of main line between Delhi and Ahmedabad are laid with a 50 lb. steel rail, which has been adopted as the standard rail for the line. The fastenings and ballasting are equal to the rail, so the exceptional cost of the permanent-way and ballasting, £1330, as compared with that of the Rohilkund-Kumaon line, £998 per mile, the Jodhpore line, £830 per mile, and the Bickaneer line, £939 per mile, is easily explained. Moreover, in the other cases, serviceable light rails were frequently available at cheap rates from main line renewals. The permanent-way of the Rajputana-Malwa is not that of a light, but of a first-class line.

In regard to the whole question of cost of "labour and material," it must be remembered that unskilled labour is far cheaper, and manufactured (and imported) material is far dearer than in Europe. These compensate one another, perhaps, very roughly, in accordance with the great contractor Brassey's dictum that the cost of work, all-round, is the same all the world over. No doubt labour in India is dearer than it used to be, and the Indian rupee, instead of being worth 2s., has been at times worth little more than 1s. in the purchase of European material, but then the price of that material has greatly decreased also. This view is favoured by the approximate equality of cost of "labour and material" on the Belgian (£1352) and Rohilkund-Kumaon (£1316) light lines. The rail on the Rajputana-Malwa is too heavy, the standard of the permanent-way is too high, the provision of fencing too complete, and the amount and efficiency of the bridge-work too exceptional, for that line to be classed as a light one. On the other hand, the peculiar advantages of the

Jodhpore and Bickaneer lines in regard to direction, supervision, survey expenses, etc., and their meagre requirements in the way of earthwork and bridging, are too special to enable us to quote them as typical Indian metre-gauge light lines.

Expenditure on "rolling-stock" and (to a less extent) on "stations and buildings" should depend upon the quantity and kind of business done by the railway. If one line costs more than another on these accounts, it should be because the traffic requires it, and in that case the greater first cost per mile is justified. Now the gross earnings per mile of the Rajputana-Malwa Railway are Rx. 1416, of the Rohilkund-Kumaon Rx. 696, of the Jodhpore Rx. 337, and of the Bickaneer Rx. 185, and (although the quantity of traffic is by no means the only important factor) the cost per mile of rolling-stock follows the same order.

Sufficient reasons have been given for rejecting the high figures of the Rajputana-Malwa on the one hand—for it cannot be called a light railway—and the low figures of the Jodhpore and Bickaneer lines on the other, since the conditions of the latter are too peculiar to justify a comparison being drawn with other light lines. But the figures of the Rohilkund-Kumaon line and of the Belgian Light Railways are so singularly parallel that it is worth while to repeat them here side by side :—

	Belgian Light Railways.	Rohilkund-Kumaon Railway.
	Cost per mile.	Cost per mile.
1. General Expenses and Sundries,	£268	£302
2. Purchase of Land,	218	2
3. Labour and Material,	1,352	1,316
4. Buildings,	286	244
5. Rolling-Stock,	580	439
	£2,706	£2,304

If we eliminate the accidental difference in the purchase of land and the independent difference in the provision of rolling-stock, we have the cost of a typical Indian metre-gauge light line and of Belgian Light Railways approximating to £2700 per mile.

To make the comparison between the average cost of Belgian Light Railways (where the range in conditions is limited) and the average cost of *all* Indian metre-gauge railways (the larger portion of which is as well built and equipped as the standard 5′ 6″ gauge railways) would be altogether misleading. And, as we have seen, it would be equally misleading to make the comparison between the Belgian figures and either the exceptionally high figures of the Rajputana-Malwa Railway or the exceptionally low figures of the Jodhpore and Bickaneer railways. Having considered and rejected these examples, a few remarks may be made about the Rohilkund-Kumaon Railway (Company's section).

This line runs from Bhojeepura Junction (12 miles from Bareilly on the main line) to Kathgodam (at the foot of the Himalayas and the terminus for the hill-station of Naini Tal), the total length being 53·92 miles. It was constructed, under a Government 4 per cent. guarantee (with a subsidy of Rx. 4000 or £2400 per annum from the North-West Provincial Government), by an English company, which also works the Lucknow-Bareilly line, and it was opened for public traffic at the end of 1884.

The rails are laid on sal-wood sleepers, which cost little, and the line is unfenced except at stations. The gross earnings were Rx. 45,931 on (adding the 12 miles between Bhojeepura and Bareilly) 66 miles worked, or Rx. 696 (£418) per mile; the expenses Rx. 24,304, or Rx. 368 (£221) per mile; and the net earnings, therefore, Rx. 21,627, or Rx. 328 (£197) per mile. On 58 Belgian light railways open at the end of 1893, with a length worked of 1156 kilometres or 718 miles, the total receipts were 4,684,355f. (£187,374), an average of 4052f. per kilometre, or £261 per mile; the expenses 3,363,490f. (£134,540), an average of 2909f. per kilometre, or £187 per mile; and the net receipts, therefore, 1,320,865f. (£52,834), an average of 1143f. per kilometre, or £74 per mile.

The ratio of expenses to receipts is, on the Belgian lines, about 72 per cent., and, on the Indian line, about 53 per cent. But the differences in the nature of the traffic, in the receipts per mile, in the working of a long and of a short lead traffic, and in the working of a considerable main line mileage (with only one branch of good length) as one system and of a number of small lengths under separate working agencies, make it impossible for us to institute comparisons where the circumstances furnish no common ground for them.

The Company's section of the Rohilkund-Kumaon railway system is only 54 miles long; but the same Company works also the Lucknow-Bareilly section and the Dadhwa branch, State-built lines, which make up the total mileage worked by the Company to 285 miles. The average lead of passengers on this system is about 33 miles; and that of goods 65 in the first, to 87 in the second, half of the year. The amount of business done, too, is much less on the Belgian than on the Indian lines. In regard to the nature of the business, it may be observed that the ratio of passenger to goods receipts is about 75 per cent. in the former case, and 42 per cent. in the latter; indeed, on most Indian railways, the goods bring in far more earnings than the passengers.

All these differences, too, prevent us from making a comparison between the rolling-stock of the Indian and Belgian lines. On the former, 27 locomotives, 166 passenger vehicles, and 674 goods vehicles suffice for 285 miles of line worked as one system. The numerous short Belgian lines require 253 locomotives, 716 passenger and 1631 goods vehicles, 140 luggage vans, and 6 special vehicles. The quotation of such contrasting figures, however, illustrates the necessity of a far larger equipment of rolling-stock to work over a number of separate short sections than on one continuous system.

If we may take the figures given for the whole of the Rohilkund-Kumaon Railway system as likely to be fairly accurate for the Company's section also, the average passenger fare per mile in 1894 was 2·6 pies, or say, 0·195d. (well under ¼d.), and the average rate per ton of goods was 5·6 pies or 0·42d. (less than ½d. a mile). The lowest passenger fares per mile on Indian railways vary, in average, between 2 and 2½ pies, but the Madras Railway (to its loss, for the reduced fares merely meant reduced profits) were much lower even than that. The lowest or second-class fare on the Belgian light lines is 5 centimes, and the first-class fare not much higher, 7 centimes.* Professor Hadley, in his *Railroad Transportation*, observes that the Belgian "passenger rates are lower than anywhere else in the world, except, perhaps, on some East Indian railroads." His cautious qualification is quite unnecessary. We must not infer that Belgian lines would gain by lowering their fares to the Indian standard. It is merely a case of not charging more than the traffic will bear. The Indian wages, both of the fourth-class passenger and of the railway menial, are generally no more than 4d. a day; so that less working expenses compensate, in this and in other ways, for the smaller fares. From an average rate per ton per mile of goods we can learn nothing. In 1894 it was 5·03 pies on the East Indian Railway, 6·50 on the Bengal-Nagpur, 6·72 on the Indian Midland, 9·11 on the Eastern Bengal, 8·36 on the Great Indian Peninsula, 7·68 on the Bombay, Baroda, and Central India, 8·59 on the Madras, 6·26 on the Bengal and North-Western, 6·33 on the Rajputana-Malwa, and 9·88 pies on the Jodhpore-Bickaneer Railway. Exclusive of terminals, fifth-class goods may pay as much as 1 pie per maund, *i.e.*, 2¼ annas (or about 2d.) per ton per mile; while first-class goods may pay as little as ⅙ pie per maund, *i.e.*, 4½ pies (or about ⅓d.) per ton per mile; and the special class goods minimum rate (as, for example, for coal and coke) is $\frac{1}{10}$ pie per maund, *i.e.*, 2·7 pies (or about ⅕d.) per ton per mile. The East Indian Railway carries three-fourths as many tons of coal and coke for the public (and over a long lead) as it does general merchandise, wherefore (among other reasons) its average rate per ton of goods per mile is a very low one; the Eastern Bengal Railway carries only $\frac{5}{17}$ths. as much coal and coke (and that over a very short lead) as general merchandise, wherefore (among other reasons) the average rate per ton per mile is a high one. Precisely the same tariff may be enforced on two given lines, and yet obviously the average rate per ton of goods per mile may be much lower on one line, which carries a large proportion of mineral traffic, than on the other, which does not. No practical use can be made of such figures, beyond the intellectual exercise of discovering a satisfactory explanation of the differences between them.

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* These are not the fares, according to Mr Cary-Elwes' figures for 1894, but in 1896 they were stated (in *The Engineer*, July 3, 1896) to be usual on these vicinal lines.

On the whole, therefore, the comparison between the Company's section of the Rohilkund-Kumaon Railway and the Belgian railways cannot be continued beyond the cost of construction. Even in the *least* favourable instances—the *whole* of the Rohilkund-Kumaon system and the Bhâunagar-Gondal-Junaghar-Parbandar Railway—the Indian percentage of working expenses to gross earnings does not exceed 57; on the Bengal and North-Western it is only 42; and on the Rajputana-Malwa Railway it is as low as 38. These are all metre-gauge lines, as are the Belgian, but they occupy the position of main lines on the map, and are worked as fairly large systems (see Appendix IV.).

If we want to find short lines with small traffic we must turn to the 2′ 0″ and 2′ 6″ gauge lines—the Jorhât (2 ′0″ gauge), 28 miles long, earning £152 a mile, with a ratio of expenses to earnings of 84 per cent.; the Gaekwar's Dabhoi (2′ 6″ gauge), 72 miles long, earning £200 a mile, with a ratio of expenses to earnings of 60 per cent.; the Cooch Behar (2′ 6″ gauge) 22 miles long, earning £110 a mile, with a ratio of expenses to earnings of 79 per cent.; and the Morvi (2′ 6″ gauge), 94 miles long, earning £205 a mile, with a ratio of expenses to earnings of 55 per cent. No quotation of figures has been made here in regard to the Darjeeling-Himalayan Railway, because it is as singular among Indian, as the Festiniog is among English, lines. But it may be mentioned that this hill line is on the 2′ 0″ gauge, is 51 miles long, cost Rx. 6009, or, say, £3605 per mile to build, earns £749 per mile, and is worked at a percentage of 59 to gross earnings. When it comes to a consideration of the ratio which working expenses bear to receipts, it is more a matter of a short line, a short lead, and of poor traffic, than of gauge. But it so happens that very often all these small conditions, including the gauge, go together.

There is one very significant factor (to which attention has not been drawn) affecting the cost of working and the equipment of rolling-stock required—the minimum number of trains per day. This, it will be remembered, is generally five in each direction on the Belgian lines. On the smaller Indian lines it need not exceed one in each direction. The supply in either case depends upon the demand, and especially upon the demand of passengers; but the fewer the trains, the longer the trains may be made up, and the cheaper they may be run—a very important matter in the working of light railways. We have a very notable instance of such economical working on the Bengal and North-Western Railway, the agent of which cannot (in the table given in Appendix V.) quote an average through speed of coaching trains, because he does not run any; his long trains are either mixed or goods; there is no frequent service of light and rapid passenger trains, because there is no demand for such. There is more time, without any practical inconvenience to the customers of the railway, to fill wagons and to give engines a full train-load, and here again is a matter to be studied to make light railways pay.

Figures of later date—for the years 1894 and 1895—show a steady, if slight, improvement in the financial results of Belgian light railways.

At the beginning of 1896* there were 1013 miles of light railways in Belgium; the nominal capital of the Society had reached £3,920,000, and there were sixty-five lines in operation, of which the Brussels-Petite Espinette was worked by electric traction (on the well-known "Thomson-Houston" overhead system) and the North-Antwerp by horses, all the rest being worked by steam locomotives.

Of four lines that had hitherto been a dead loss, the Deynze-Audenarde not only paid off its previous losses, but actually gave a dividend; the Thielt-Aeltre paid off a portion; and the other two showed some improvement. The total loss in working up to date was £3244, which the special reserve funds of each line could cover 2½ times over, and the general reserve, 5 times.

In 1893 only fourteen lines yielded more than 3½ per cent., giving the shareholders a second dividend. In 1895 there were twenty-three lines able to declare more than 3½ per cent.

The total receipts in 1895 were 5,903,465f., or £236,138; the working expenses 4,091,110f., or £163,644; and the net receipts, therefore, 1,812,355f., or £72,494. This makes the ratio of working expenses to total receipts 69·3 per cent., as compared with 71 per cent. in 1894 and 72 in 1893.

Benefits.—As some indication of the general benefit to the country of Belgian Light Railways, the following quotation from Mr Cary-Elwes' report is interesting:—

"Agricultural products have certainly been benefited by the establishment of light railways, the most remarkable instance being the culture of beetroot, which has received a great impetus, and has, in its turn, given rise to the establishment of a large number of sugar factories.

"Another industry which has notably profited by the increased railway accommodation is that of stone-quarrying, several quarries which had been abandoned owing to insufficient means of transport having been re-opened, in addition to new ones started. Market gardening has also been successfully encouraged, and vans specially adapted to the carriage of baskets of fruit and vegetables have been built. So great has been the success of the easy means thus afforded to the people of taking agricultural produce to market that a special night train has had to be put on, which enables peasant farmers and gardeners to arrive very early at the market, and to be back again at their homes by 6 o'clock the same morning.

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* *The Engineer*, July 3, 1896.

"This train has been taken advantage of particularly by growers of strawberries."

While we are upon the subject of the probable benefits of light railway projects, the hopeless endeavour of the sanguine statistician to base a rule upon only one or two factors, where an infinite number of factors are concerned, is illustrated by such a question as the following:—

What minimum of (*a*) density of population, (*b*) wealth, would justify the formation of light lines in a given district?

Now, if we are to wait for density of population and wealth in a district to justify us in making light railways, we shall very often have to wait for ever. In most cases we shall be obliged to look to density of population and wealth as the probable results, instead of the existing causes, which justify such projects.

To such a question, however, the National Society manages to give an instructive reply.* Their lines are laid in well-populated commercial centres, exclusively intended for passenger traffic; but it is impossible to say how many inhabitants are really served by them, because railways of standard gauge already run through the district. The energy of the inhabitants must be taken into account, and the trade and industries of the country traversed. For lines intended for both passenger and goods traffic, there *is not and cannot be* any fixed minimum of inhabitants to justify their construction. The population may be scanty, but the land may be fertile, promising ample traffic in agricultural produce. Or, industries may be tapped which ensure considerable goods traffic. Where these inducements are less, the population to be served must be greater. On the other hand—and this is still more destructive of the practical value of a question of this sort—it is not impossible to find an agricultural district, such as those served by the Dutch railways, where the population is both (*a*) dense and (*b*) wealthy, and yet the traffic is poor.

The problem may be compared to an equation with an indefinite number of terms—

$$x = a\mathrm{A} + b\mathrm{B} + c\mathrm{C} + \ldots\ldots\ldots\ldots$$

where certain values have to be assigned to A, B, C . . . , representing density of population, wealth, agricultural produce, manufactures, etc., and also certain values to the co-efficients a, b, c . . . , measuring the actual effect of the factors A, B, C. . . . In such a case, how far is an advance made towards a solution of the problem by determining the first and second terms, if we leave the others untouched? We cannot profitably make precise calculations in one particular, and ignore the others, when they all conduce to a large result.

Co-operation of State and People in working Light Railways.— It may not be out of place to make a few remarks upon the part taken by the Government in light railways in Belgium. "Railroads," says Professor Hadley,* "insisted on coming whether monarchical Governments liked them or not, and they did so much good when they came that the Government soon decided that they were a good thing, and gave their paternal assistance, either in the form of guarantees of interest or of direct State construction." It is due to King Leopold that Belgian railway work was started as early as 1833. The increase was comparatively small, however, between 1850 and 1870. Then the Government began to buy up the private lines, until in 1880 it owned two-thirds of the mileage of the country. Now, as we have observed at the beginning of this chapter, the whole is practically under State management.

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* *Bull. de la Comm. Internat. du Congrès des Chem. de Fer*, vol. ix., 1895.

From the first, the Belgians were used to State ownership of the standard railways. There was, accordingly, no time-rooted objection to State aid and State control of light railways to be overcome. The main-line system of standard railways practically belongs to the State and is worked by the State. The light-railway system is much more complex in its organisation. The State is its head, but the monopoly of all light railway concessions is given by the State to the National Society; and the shareholders in this company are the State, the Communes, the Provinces, and private individuals; yet these shareholders have no part in the management of affairs, the directors even being appointed by the State; and the actual working of the lines is leased out by the Society to other individuals, companies, or associations formed by the local authorities. We have here a most interesting combination of the State, a society—which is at one and the same time a private company and a department of the State—and, either as shareholders or working agencies, the people, separately as private individuals or associated as local governing bodies or independent companies. The Government, a monopoly, and private enterprise are happily joined together. There has been a certain amount of friction between the National Society of Light Railways and State Railways; but they meet on more or less equal terms as officials, and their relations are far easier than would exist in England between a similar company with a light railway monopoly and the great private corporations to which our standard railway system belongs. The delegation by the State to the Society of the promotion, construction, and administration of all light railways has made the marvellous development of the latter in Belgium possible, but the application of the same method to the different conditions of Great Britain might meet with little favour.

Taking into consideration the actual percentage paid by Belgian light railways, as a whole, and their total effect upon the country districts, M. Colson's opinion † that their organisation had been favourable to their construction but not very satisfactory in regard to their working can scarcely be accepted.

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* *Railroad Transportation*, by Prof. A. T. Hadley, p. 209.

† *Bull. de la Comm. Internat. du Cong. des Chem. de Fer*, 1891,—"La Législation des Chemins de Fer Économiques."

CHAPTER IV.

LIGHT RAILWAYS IN FRANCE.

CONTENTS.—Railways initiated and aided by the State—Railway system planned, radiating from Paris—Great companies and subsidiary lines—Failure of the law of 1865—Facilities under the law of 1880—Light railways under local administration—Annual State subsidies—Based on revenue working, not capital expenditure—Departmental construction—A working formula required—Influence of the law of 1880 on local promotion—Aid afforded by the great companies—Financial results of French light railways—Tramways of the Charente Inférieure—Light railway from Caen to Dives and Luc-sur-Mer—Light railway from Pithiviers to Toury—Light railways in the Landes—Considère's and Colson's views on light railways as feeders—Their contribution of traffic to main lines—Their direct and indirect benefits to the public—Reduction of rates to incremental cost of service—Evolution of a traffic formula.

State Railway System.—While Belgium, as we have seen, adopted the principle of State ownership in regard to the main railway system, and the principle of State aid and control, through the medium of the National Society, in developing the light railways, the French Government, from the first, entered on a policy of State aid, reserving to itself large powers of control. It had not only to make the best terms it could with private companies offering to build the first great lines, but frequently its assistance had to take the practical form of surveying and even constructing the railways before the companies could be induced to take them up.

In France—and, indeed, in all countries but England and America—we discover a dependence upon State initiative and a regard for symmetry and system which are strange to us. When an Englishman or American sees his way to a big thing he only asks the State to let him alone; nor does he waste time in considering whether the particular thing he wants will ultimately fit in accurately with some general design; so long as he can accomplish his immediate purpose in his own way, he is content to leave it to others to find a consistent theory to explain his practical success. The Frenchman, however, likes to have a symmetrical and comprehensive scheme before he attempts to carry out the details. Accordingly, a perfectly-planned system of railways radiating (with one exception) from Paris had to be devised. This caused some delay, and France did not push forward with her railways very rapidly at first. Little was done before 1842.

The State was to contribute rather more than half the cost, private capital the remainder, and the railways were to revert to the State in forty years or so.

In 1848 there was a check; but, in 1851, Napoleon III. extended the duration of the companies' charters to ninety-nine years from that date, in order that their permanent position might be assured and their development encouraged.

A few years later, five or six main lines radiating from Paris held a monopoly, each within its own area, of the through traffic, and were not at all concerned to develop local traffic. Secure in the possession of the through traffic, they had no inducement to build branch lines for the development of local traffic, the prospects of which were doubtful, and the profits much less remunerative. In 1859, however, a distinction was made between the "old network" (*ancien réseau*) of paying main lines and the "new network" (*nouveau réseau*) of less profitable extensions, which the great companies were invited to construct under the most liberal guarantees of interest by the Government; if the lines paid, the companies bought out the Government, and, if they did not, the Government had to make good their guarantee; so that the companies got more profit out of it than anybody else.*

The law of 1865 attempted to establish local lines independently of the great companies, and was, therefore, quite a new departure. The local authorities were empowered to advance money for the construction of cheap branch lines. Unfortunately, having been built on the standard gauge, these lines, which were intended to be purely local and tributary, combined, in spite of prohibition, to form continuous routes competing with the main lines. They became involved in speculations and expenses beyond their means. And, after coming to utter grief, most of them were bought up, either by the State or by the great companies, and were absorbed into the main line system.

The law of 1880 was framed to give new life to light railway development, and applies to tramways as well as to local railways (*chemins de fer d'intérêt local*); by a *tramway*, in French legislation, we must understand a railway laid wholly, or for the most part, on a public road. This law does not release local railways from the operation of those general regulations which apply indifferently to the construction of all lines, great or small; but particular requirements, affecting the gradients, curves, number and speed of trains, rates, etc., are separately prescribed in the specification for each railway (a standard form of specification, which is almost invariably adhered to, having been adopted in 1881 for local railways and tramways). The only general order of a technical kind relating to light railways, in the law of 1880, is that which empowers the Prefect of a Department to exempt them from the obligation—rigidly enforced in the case of large lines—of providing continuous fencing and level-crossing gates. The speed on light lines is limited by the Prefect. Women are frequently employed. Examination of stock on running trains is not enforced. Block instruments and telegraph are not required; telephonic communication, which is cheaper than telegraph, is permitted; these single lines may be worked by staff. Triangles replace turn-tables. The length of trains, by the decree of 1889, is limited to sixteen vehicles; but a buffer-vehicle between the engine and the first passenger-coach is not required; nor, if the train be fitted with the continuous brake, need there be a special brakesman in the last vehicle, or a fireman on the engine. Three trains daily each way are the usual minimum of service, with a subsidy for extra trains. Stations and approaches need not be lit until fifteen minutes before an evening train is timed to arrive. Such are the simplifications of working which may be inserted in the specification for a local line.

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* *Railroad Transportation*, by Arthur T. Hadley.

The majority of local railways have adopted the one-metre gauge, but this does not determine their *differentia* from ordinary railways, several of which have been constructed on that gauge. The distinction between them is rather administrative and financial.

Light Railways under Local Management Subsidised by Aid from State and Main Line Companies.—The ordinary railways are subject to State administration and centralisation. The local railways are under departmental or local administration, and all powers reserved in the specification to public authority—such as approval of the project, the arrangement of time-tables, and the classification of rates—are placed in the hands of the Prefect of the particular Department without reference to the Minister of Public Works.

The relief afforded by administrative decentralisation, however, has done less for the growth of light railways than the financial facilities introduced by the law.* It deals only with the terms on which State grants may be made, leaving the actual details of the concession to be determined by the local authorities. State grants may be made without imposing any other obligations. These subsidies take the form of annuities amounting to not more than 5 per cent. on first cost capital, and must not increase the gross revenue of the railway beyond 10,500 francs per kilometre (£676 per mile) of broad-gauge line, 8500 francs per kilometre (£547 per mile) of narrow-gauge line, or 6500 francs per kilometre (£418 per mile) of tramway. The State will only grant this annual subsidy on condition that the local authorities who give the concession, with or without the co-operation of other interested parties, furnish at least an equal subsidy; and, if the latter takes the form of capital or works, instead of an annuity, it is equated as an annual charge of 4 per cent., including amortisation. Under the law of 1865, the public aid was given to capital; under the law of 1880, to revenue.

By making its subsidy an annual addition to revenue, instead of an immediate addition to capital for construction, the State hoped to strengthen the working of the line, and at first the Departments followed the same course, with the same object. Unfortunately, the lines thus established discovered in such conditions no great inducement to improve their working. The concessionnaires found their profits in raising the capital and promoting the construction of the lines; after that, they were guaranteed interest at 5 per cent. of capital, and knew well that, even if they exerted themselves to the utmost in the development of traffic, they could never *earn* that minimum of revenue.

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* "Exposé de la Question de la Législation des Chemins de fer Économiques," by M. Colson,—*Bull. de la Comm. Internat. du Congrès des Chemins de Fer*, 1891.

It became very evident that, if the system of annual subsidies was to prove satisfactory, the working expenses should be calculated in accordance with a revenue formula, not a capital formula. In many cases, however, the effect of some of these formulæ was to content the working agency with such traffic as offered and could bear high rates; they promised no further remuneration for developing traffic by a reduction of tariff, or for attracting more business by multiplying and improving the service of trains.

Another suggestion occurred to the Departmental authorities. If, with their superior credit, they could borrow money at a much lower rate of interest than had to be guaranteed to concessionnaires, why should not the Departments themselves raise the construction capital, and force the concessionnaires who took up the lines to seek their profits in an expansion of revenue, enterprising management, and economical working? M. Colson's chief fear was that the Departments, unless checked by higher authority, might go too far in that direction. The concessionnaires should at the very least furnish the rolling-stock; for, if the line were handed over to them fully equipped, what was to prevent them from throwing up the contract whenever they got into difficulties? Only the exaction from them of a considerable security, which means tying up money instead of utilising it. When this system of Departmental construction is adopted, moreover, the working agreements are for comparatively short periods; and, in order to ensure the proper upkeep of the way and stock for which the Department has paid, it becomes necessary to deduct, from the share allotted annually to the concessionnaires, a certain amount to be devoted to the formation of a maintenance reserve fund. Such, too, was the experience of the Belgian National Society.

The custom of making good deficits on working expenses was gradually discontinued. If the gross receipts were less than the working expenses, they were handed over to the concessionnaires up to a certain figure. There was thus a limit to the charges falling upon the Departments, and little inducement to promote lines which were not likely even to pay the cost of working. As, however, the line improved, and the receipts grew, the Departments would very naturally want a fair share of the profits, and here they were exposed to two dangers: if too large a share of the surplus were surrendered to the concessionnaires, there was no chance of substantially reducing the charges borne by the State and the Department, no matter how prosperous the line might become; if, on the contrary, the concessionnaires did not get enough of the surplus, they would not do their best to increase it. The concessionnaires to whom the line was leased might see their way to a reduction of tariff, an improvement of facilities, and an expansion of traffic which would benefit the passenger, the shipper, the district, and the country at large; yet the fraction of the surplus allotted to them might not repay them for the trouble, the cost, and the sacrifice involved. The contradiction in terms of formulæ based on gross receipts seemed an insoluble difficulty. Experience had not yet stamped with its absolute approval any of those formulæ which endeavoured to combine, with a division of receipts, a due valuation of the nature of the traffic and the conditions of working. In 1892, however, the year after M. Colson's paper was published, M. Considère enunciated a formula which won his warm approval, and the discussion which ensued between these two distinguished experts will be referred to in some detail later on.

In regard to the formation of capital by a company holding a concession, the law of 1880 required that the issue of debentures should be subject to the authority of the Minister of Public Works, and that, only in special cases where the solvency of the promoters was beyond question, should the amount of debenture capital be permitted to exceed that of the paid-up share capital.

The burdens laid upon the concessionnaires of State-subsidised local lines in the way of public services, although not so great as those borne by ordinary railways, were sufficiently heavy, including as they did the free carriage of mails.

The law of 1880, with its promise of fewer risks, but smaller profits, seemed to favour the formation of local companies by those whose property or business would be likely to benefit by a railway passing through the district. It appealed less to outside promoters or contractors, who, if they take up schemes in various parts of the country, like to be able to consolidate their management under one common direction. The effect of the later and more prudent policy of limited subsidies has been to induce the Departments more and more to take the construction of local lines into their own hands, and then to lease out the working. This, however, increased the charges upon the Departments, and once more opened the way to intervention on the part of the great companies in some cases.

No doubt, the interest of a great company's main line in the promotion of a tributary local line would seem to be more immediate than that of the State, which could only find compensation for its assistance in general, indirect, and even remote gains. No doubt, also, the State should only take action after those who are more immediately concerned have failed to do their part. But all along the great companies had shown no inclination to take the lead in the development of minor railway connections, and it was not until there was a reaction against the tendency of the law of 1880 that the assistance of the great companies invited notice.

The Northern has bought up some branches which could not pay their way; capital has been advanced by the Northern and Eastern, and interest has been guaranteed by the Southern, to tributary lines.

All the great companies afford junction facilities to light lines at moderate rental. Very often the ratio of the light line's share of expenses to that of the main line is as the traffic-units of the light line to the sum of the traffic units of both lines.

Main lines working light lines sometimes take from earnings only their actual expenses—cost of maintenance, rolling-stock, fuel, and the staff actually resident on the line—requiring nothing on account of general charges or station rent. This is very much the sort of lenient treatment which the (2′ 6″ gauge) Cooch Behar (native) State Railway in India received from the Eastern Bengal (Government) State Railway; actual expenses only were charged, and the services of the superior staff were rendered gratuitously.

Through rates and through services between the great lines and these branches do not prevail. M. de Bäcker* argues that through consignment is only beneficial when it is accompanied by a reduction of rates; that this means a decrease in the fixed charges; and that this loss falls upon the smaller line, since it has to do all the work—shunting, marshalling, transhipment, etc.—which these fixed charges cover. The Northern Railway grants a feeder line a rebate per passenger, which varies with the number of passengers brought to the main line, but, says M. de Bäcker, "this would seem to be exceptional; however, it shows so keen a sense of justice that it deserves marked attention."

We may sum up in a few words the relations which have hitherto existed in France between these light railways on the one hand, and the State, the Departments, and the great railway companies on the other. At first, as we have seen, the promoters constructed and equipped the line at a certain cost, and the State and Department paid interest on that at a rate which is far higher than the present market rate; and then the promoters received, for working the line, a constant sum *plus* a percentage of the gross receipts, while, if the latter fell below a certain figure, the State and the Department had to make up the deficit. This system of guaranteed interest was too extravagant to be continued, and the later system was for the Department to build the line, and then to lease the working of it to a contractor, whose remuneration is determined by formulæ designed to make him personally interested in the development of traffic.

The Financial Position of Light Railways.—In 1894 the construction capital on account of local railways had reached £13,250,000, the gross receipts were £720,000, and the net revenue only £120,000. Tramways, or light railways on public roads, added £2,750,000 more capital, £200,000 gross receipts, and only £40,000 net revenue. The State had to pay £132,000, and the Departments £224,000, in the shape of guarantees on these local railways and tramways, and M. Colson, in reviewing these figures,* advised that, while the construction of new secondary railways of general interest (with which we are not concerned) should cease altogether, that of lines of local interest should not be too actively pushed on, for their extension was likely to add considerably to liabilities which were already sufficiently serious.

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* *Bulletin de la Commission Internationale du Congrès des Chemins de Fer*, 1891.

The interesting but discouraging "Report on the Tramways of the Charente Inférieure," drawn up by Mr Stovin Warburton, Her Majesty's Consul at La Rochelle,† although it deals in detail with the light railways of only one Department, takes a most unfavourable view of all. Unfortunately, the subject of light railways in France was still too controversial to enable M. Hanotaux to express a pronounced opinion upon their administration, and Mr Warburton's report is the only one published. If, as he says, the carts really cut out the railway on the very same roads, it must be a very bad case. But it is so; he says that agricultural produce is preferably carried by cart to market towns ten or twelve miles off. Difference of gauge between the main and light lines must be largely responsible for this.

The reader will remember that the term "tramways" means such lines as we are concerned with, as Mr Warburton explains, and the report deserves quotation *in extenso*:—

"During the past year there has been a considerable amount of tramway construction in this district, and as the subject is one which has attracted a good deal of attention in our own country of late, where the advocates of tramway-making at the expense of the public have supported their views by quoting the example of this country as an argument in its favour, I think it well to give such information as I have been able to obtain concerning these lines, as well as on the tramway question generally.

"The distinction made here between tramways and light railways does not depend upon the mode of construction, but on whether the lines run along the public roads for a certain proportion of their length or not.

"Any line that runs for more than two-thirds of its whole length on or along the sides of the public roads is a tramway, and one which does so for a lesser distance is a railway.

"In this Department they are constructed for about 30 per cent. of their length on lands purchased for the purpose, and for 70 per cent. of it along the roads, and, therefore, not being able to show the proportion necessary to make them tramways, are classed as railways, although commonly described as 'the tramways of the Charente Inférieure.'

"The formalities necessary before the construction of the lines is permitted vary also according to the nature of the ground on which they run.

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* *Revue des Deux Mondes*, January 15, 1896.

† *Reports from Her Majesty's Representatives Abroad on Light Railways* (Commercial, No. 9, 1894).

"If they are made (wherever they follow the roads) on those which belong exclusively to the Department or the Communes, the Council-General of the Department can authorize their construction. If, on the other hand, any part of them runs along a road belonging to the State, such as a national road, or the wharf of a maritime port, the concession can only be obtained from the State, and this last is the case with the tramways of the Charente Inférieure, which have been authorized by a Decree from the President of the Republic.

"The cost of making the lines is then paid by the State and the Department; here each provides one-half, but the latter has to find the money in the first instance, as the State contribution is not given in cash, but in the form of an annuity spread over a term of fifty years.

"This is how the matter was carried out here. The Department is the paymaster, and advertises for a contractor willing to construct the lines, and also to work them during the whole of the concession, which is for fifty years, engaging to repay him the actual outlay incurred, provided it does not exceed a maximum sum agreed upon, which in this instance is fixed at £2735 per mile, and includes cost of land purchased, running stock, and everything else.

"But the contractor does not receive the whole sum in cash, only being paid three-fourths of it; the remaining fourth, being considered as a contribution from him, is deducted from the total sum due, according to his tender, and he is allowed interest on it at the rate of 4 per cent. until his concession expires.

"The working of the lines is entirely at his risk, but a calculation is made when giving out the contract as to the probable cost of maintenance and working, as well as of the probable receipts.

"I am informed that here the estimate agreed upon between the Department and the contractor was that it should be put at £76 per mile, plus two-thirds of the gross receipts.

"The tramways of the Charente Inférieure are intended for the transport of agricultural produce, goods, and passengers; the width of gauge is nearly 40 inches, which has been chosen as likely to be the most useful size; the locomotives weigh 15 tons, and the wagons can carry a load of 10 tons, so that practically they are railways running along the roads for most of their length.

"Having described these lines, which are similar to others lately made in different parts of France, the question naturally arises as to the benefit derived from them by the districts into which they have been introduced, and on this subject, having consulted persons competent to form an opinion, I have found it to be generally unfavourable.

"There may be instances in which these lines have been a success, either financially, or by developing the resources of the district to such an extent as to make up for the loss to the public purse which they generally involve, but I believe them to be very rare, and I should require very strong evidence that this was so in any case before I could credit it.

"It is rather soon to pass a judgment on the services which the tramways of this Department may eventually render, but at present I cannot see that they have any chance of doing so to an extent which can ever compensate for the amount of money spent on them.

"They run through an agricultural country principally, so that it is to persons engaged in this occupation we should expect the principal benefit to accrue, but I believe that they will be very little used by most of them.

"The line passes by hundreds of farms of moderate size (say, from 20 to 200 acres), mostly tillage, which necessitates the use of horses and carts, several of which are generally kept on each farm.

"The farmers have produce to sell, but it is generally sold at the different market towns for ten or twelve miles round, and delivered at the buyer's house.

"The tramway only runs from one point to another, and if it passes through a certain number of market towns, it leaves a far greater number equally near to any particular farmer untouched, so that in their case it is of no use to him at all.

"But even when it runs to the exact place to which he wants to send a load, he has first to cart it from his farm to the tramway, then load it on the wagons, and at the end of the journey put it on another cart to get it to the house of the purchaser if sold, while, if not, it has to be sent home in the same way, so that there are very few farmers who do not prefer to load their stuff and send it direct to the place of sale than to go through all these operations, and the idea of running sidings from the lines up to the farms is entirely illusory in this country, for no one would think of doing it.

"The lines can therefore be of very little use to agriculture, and as the district is not a manufacturing one, or sufficiently populous to provide the amount of goods or passenger traffic which would enable them to pay the expenses of working, it is not easy to see what advantage will be derived from them except to a very limited number of persons.

"I believe this to be the case in most of the tramway lines which have hitherto been constructed (in a greater or less degree), and it will naturally then be asked why they were ever made at all?

"The answer is, simply because of the great facility which exists for obtaining public money for these and other undertakings, which would never have been attempted if they had to be made with private capital and for commercial reasons.

"If the arrangement by which the funds are obtained is looked into, it will be seen how great an inducement is offered for getting up undertakings of doubtful wisdom when this can be done at the public cost.

"In this case, half the charges are paid by the State in the first place, which would present some difficulty if the money had to be paid down in cash, but the objection to providing so large a sum at once is got over by making it an annual payment extending over fifty years.

"The Department naturally wishes to profit by the outlay of this large sum, of which it only pays an infinitesimal part, and in order to do so has to provide the same amount, which it is able to do without inflicting on itself any additional taxation to signify, by borrowing the total sum required at a very moderate rate of interest, which during fifty years will be in a great part paid by the Government annual grant, so that till the end of that period nobody will be much the worse off. This would not be so if they had to make up any great loss on the working of the lines, but this is guarded against by the arrangement made with the contractor to work as well as construct them, by making him subscribe one-fourth of the capital, and by paying him the interest of this sum during the period of the concession.

"Of course, this increases the cost of the undertaking, as he must consider it in his tender, but if it does, it also increases the half paid by the State and the annual payment in lieu of ready money.

"It does not seem to me very surprising that, under the circumstances, every part of the country should wish for tramways without looking very closely into the question of whether they are likely to benefit the rest of the country at some future time, for there can be no doubt that they benefit some persons at once, and the expenditure of a large sum of money is always popular in a district when the taxpayers are not called on to pay more on account of it.

"I have read a great deal of correspondence during the past year as to the desirability of constructing tramways at the cost of the State or county districts in England, and the advantages which would result to the country generally from an expenditure of public money in this way.

"On this subject I am not competent to form an opinion, but one argument used by the advocates of it appeared to me a very fallacious one.

"It was, that it had been done in France on a large scale for some years past, and that as most of the lines did not work at a profit, the direct loss to the State must be counterbalanced by some indirect advantage to the population at large, or they would not be made.

"This is exactly what ought to be proved before the money of the public is spent on them, but I am afraid that it will be found very difficult, and that if such proof had been required here many lines would never have been constructed.

"Persons who wish us to follow the example of this country should remember that here it has been for many years the practice for the State to contribute liberally towards undertakings of every kind.

"Tramways form a very small item in the gross sum which is thus granted annually, and they are often the only undertaking on which money can be so spent in a particular district.

"In these Departments bordering on the sea, millions have been granted by the State for making and improving seaports and for other maritime works of little advantage to the inland population, which expects its share of whatever is going in the shape of Government aid, and will insist on having it.

"Then the political question steps in, and these districts have Deputies and Senators like other places, whose first duty is to their constituents, and if they neglected it, and were not able or willing to secure this share for them, their places would be very likely to be taken by others possessed of more energy or more influence.

"The electors of a district consider that they are the best judges of what is good for them, and it seems a hard case to refuse a grant for a tramway on the ground that it will not pay if they wish to have it, when their neighbours in the same Department have been given sums five or six times as large for other undertakings which pay no better.

"I believe that this was the case here, and that some prudent persons in other parts of the Department did at first oppose the tramway scheme as a waste of money, but were met with the answer, "You have got millions for your district, and you want to prevent us from getting a few hundred thousands for ours.

"I think, however, it will be found that, owing to their want of success, tramways are going out of fashion in this country, and that people are not so anxious for them as they were.

"I am told that many lines which had been projected will not now be carried out, and although the mere finishing of the systems already begun, and which cannot be stopped, may amount to a considerable mileage per year until they are completed, I have reason to believe that after this year tramway construction will show a considerable falling off in this country.

"An experienced engineer, who supported the tramways of this Department, informs me that since seeing their working, he has entirely changed his mind about them, and will never again vote for a steam tramway in rural districts unless it is entirely constructed on land purchased, and does not run anywhere along the public roads.

"My informant considers that in order to justify the outlay incurred in making tramway lines, every mile of their route should be able to feed them with light or heavy traffic in proportion to their cost of construction and working expenses, and that in order to fulfil this condition they must be made in one of two ways:—

"1. Cheap to construct and work, and in this case they should be only what used to be known as a tramway, viz., a line running for all its length along the public roads, with light rails, carriages, and wagons, which enables a service to be kept up of carriages running frequently at small cost.

"This kind of tramway requires to be worked by horses, or by engines of a lighter and more economical build than any at present in use in this country, but except in or near large towns it can scarcely ever pay.

"2. By making it (as has been done here and elsewhere) a railway more or less light, worked by ordinary steam locomotives, capable of moving a large amount of tonnage in heavier trains running less often.

"A line of this description cannot be run entirely along the public roads in this country for several reasons, one of which is that very few of them are wide enough to allow it to be done with safety, and land must therefore be purchased, which, as I have mentioned already, has been done here on 30 per cent. of the whole route, thus enormously increasing the cost, and even this has been insufficient, for where the line does follow the highways, owing to their narrowness, many accidents have occurred through horses being frightened, carriages upset in consequence, or from the wheels getting caught in the rails, with the result that a considerable share of the gross earnings is, I hear, likely to go in damages.

"Again, the working expenses are very heavy, owing to the rise and fall of the ground on the road parts.

"In one section of about sixteen miles the locomotives have to work the traffic on an incline of as much as 1 in 30, and they are themselves so heavy when fully provisioned with coals and water, that they can only draw a load of two and a half times their own weight.

"This does not matter very much at present, there being so little traffic, but if what is one of the arguments in favour of tramway-making proves correct in this instance, and that sufficient traffic is developed to make the line of benefit to the population as a whole, the line will have to be abandoned and a regular railway constructed in its place, entirely on purchased land, so that the steep gradients may be avoided.

"I cannot help thinking that it would have, under the circumstances, been wiser to have spent a very small part of the outlay incurred on improving the public roads, which, in this Department, are far from perfect, but then no grant from the State could have been obtained for such a purpose. The general impression now in this country seems to be that the solution of the question of rural traffic does not lie in tramways, but in mechanical traction on the ordinary roads, and that the only difficulty in the way is the want of a locomotive suited to them, and which will not be obliged to carry the great load of coals and water which they do at present; this has not yet been constructed, but the experiments lately carried out in France seem to indicate that the difficulty is most likely to be solved by the use of petroleum as fuel.

"If this should turn out to be the case, I feel sure that many country districts will regret having saddled themselves with a costly system of tramways which must be paid for some day, even if the burden is not felt at present, and when we remember the enormous indebtedness of the Communes, any addition to it must appear to be a serious matter.

"This debt, which, in 1862, amounted to £26,000,000, or 15s. per head of the population, had risen in 1890 to £129,000,000, equal to £3 4s. per head, and must have largely increased since then owing to the liberal expenditure on public works during the last four years, which has been facilitated by the low rate of interest for loans secured by county or municipal guarantee.

"There may be (as I have said already) some lines of tramways which are exceptions to the general rule, and have proved a success by benefiting the country generally or paying their way, but I believe this will be found to be owing to exceptional circumstances, such as their supplying a missing link in a railway system, or passing through districts where there are prosperous sugar factories or distilleries.

"One in particular is always quoted, that between Pithiviers and Toury, but I believe it combines both these advantages to a degree not found elsewhere, and still its earnings have not hitherto been sufficient to prevent loss in the working.

"As to others, I have never heard anything beyond the general statement that they benefit the district, without any facts or figures being given to prove it."

This is a somewhat depressing report, and it will be noticed that Mr Warburton is very sceptical in regard to the "indirect advantage to the population at large" of such lines. But it must be remembered that his point of view is that of the average practical Englishman who believes only in a scheme that will stand on its own legs without any official props. It will be only fair to quote a few more cheerful figures* regarding the 2 feet gauge light line, from Caen to Dives and Luc-sur-Mer in Normandy, built and equipped by the Decauville Company, who were granted a concession in 1890. The line is nearly twenty-four miles long, and cost £50,594, or about £2143 per mile. In 1894 the profit was about 7½ per cent. on the capital of the Company, and the growing surplus, during three years of working, is seen in the following table:—

Year.	Number of Passengers Carried.	Total Receipts.	Working Expenses.	Surplus.
		£	£	£
1893	215,233	6754	5189	1565
1894	256,664	8288	5302	2986
1895	...	8930	5271	3209

The gauge, 2 feet, of this light railway was chosen in preference to that of 2 ft. 6 in., because the latter was too near the existing metre-gauge, a reason which would not, of course, obtain in England, and has not prevented us from adopting the 2 ft. 6 in. gauge in India. Both at Dives and Luc-sur-Mer the line touches the Western of France. The track is laid mainly along the side of the public road. Besides ordinary traffic, there is extra traffic in summer between Caen and the coast, and even in winter, on market days at Caen, a good amount of business is done in passengers, goods, and farm produce from and to the rural districts. The smallness of the gauge, and the portability of the permanent-way, make temporary extensions easy, and the lines may be run down to the fields during harvest, and shifted as required.

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* *Engineering*, Feb. 28, 1896.

The permanent-way is of the Decauville pattern, and weighs 89 lbs. per yard. It consists of rails, weighing 30 lbs. per yard, fastened to sleepers weighing 24¼ lbs. by two inside and one outside rivets, and is laid in sand ballast, topped with gravel and stones. Level-crossings over roads are paved.

Land (which has frequently been a costly item on the liberal valuation of juries composed of peasant proprietors) was free, and there is no fencing.

There are fifteen stations—some with sheds only, others provided with a small office—two running sheds and one repairing shop. Telephonic communication has been established on the return wire system.

The curves are sometimes sharp, one having a radius of only 65 feet, and gradients are as steep as 1 in 33. All the passenger, and most of the goods, stock run on bogies. The automatic brake is used.

Third-class passenger vehicles, carrying 56 passengers, weigh 3½ tons. They are made open for summer traffic. Mixed first-class and second-class passenger vehicles—composite—are closed carriages with a central passage. Composite passenger and luggage vehicles are in use.

Of goods wagons, besides special cars for bullocks and horses, there are two types. The smaller carries 5 tons on two axles. The larger, which carries a 10-ton load (a standard gauge load), does not weigh more than 3¼ tons.

Since 1893 there has been a reduction in train-mileage expenses and an increase in train-mileage receipts, the latter having been 1s. 9½d. in 1893 and 2s. 1d. in 1895, the former 1s. 4½d. in 1893 and 1s. 4d. in 1895. As regards the capacity of this small line, it is said to have carried 61,405 passengers in the month of August, or an average of 2000 per day.

Another line on the 2 feet gauge may be mentioned, that from Pithiviers (Orleans and Malesherbes Railway) to Toury (Paris and Orleans Railway).[*] It was referred to in Mr Warburton's report above.

This railway was constructed by the Council of the Department to encourage the cultivation of beetroot and the manufacture of sugar.

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[*] Foris on "Light Narrow-Gauge Railway in France" (*Le Génie Civil*, vol. xxv., 1894). *Min. Proc. Inst. C.E.*, vol. cxviii., 1894. Foreign Abstract.

Its working has been leased to the Decauville Company, the terms being that, in any year, if the gross receipts are less than £116 a mile, the Department shall pay the Company half the difference; if they are more than £148, the Company shall pay the Department half the difference; and, between these limits of gross receipts, no payment shall be made either way. The Department hoped also to save something in road maintenance.

The line is nineteen miles long, with seven intermediate stations, and six other stopping places where passengers without luggage may join the train. The track is laid on one side of the public road, and is not separated from it in any way. Most unfortunately, the opposition of the Communes forced the line to make a détour round the villages instead of passing through them. At the stations are an open passenger shed and a parcel office containing a weighing-machine. The conductor issues tickets on the train. The gradients are generally about 1 in 100.

The rails weigh 19·1 lbs. per yard, and are cold-riveted to steel sleepers, with six inches of ballast under the sleepers. There are two goods engines, compound on M. Mallet's system, weighing 9 tons empty and 12 tons full, and two passenger engines, weighing 7·2 tons empty and 8·5 tons full. Of wagons, besides a cattle-wagon bogie, there are two types, one being 5-ton four-wheelers for beetroot, and the others 10-ton open bogies weighing 3·17 tons. The cost was £1223 a mile, or, including equipment, £1551 a mile.

Important branches have been laid down by cultivators and manufacturers.

"Roselly," in *La Voie Ferrée*, has given some interesting particulars* regarding a group of five local lines, aggregating one hundred miles in length, traversing a desolate sandy desert in the Landes, and owned and worked by an independent company, to which the Great Southern Railway has given a guarantee of 5 per cent. on capital. These lines were opened in 1891. In 1893 the gross receipts were £18,000 (about £3 10s. per mile per week), the working expenses £11,000 (£2 3s. per mile per week), and the net earnings £7000 (£1 7s. per mile per week).

A reference to the short table at the end of the book, compiled from the Railway Returns of the United Kingdom, will show that the gross receipts are very poor indeed. It is all the more remarkable, therefore, that the proportion of working expenses to total receipts should be so low as 61 per cent.,—about the same as the Festiniog Railway can boast of with nearly seven times as large receipts, and very creditably approaching the figures which we find opposite the names of the great railways in that table.

The Landes light lines cost £3200 per mile; and the interest and sinking fund on a capital of £320,000 demanded an annual charge of £18,000, of which the Southern Railway had to make up £11,000.

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* *Transport*, January 4, 1895.

But then the Southern Railway received £32,000 gross receipts on contributed traffic, and this traffic was worked at very much less expense than 56 per cent. of the receipts, the average percentage obtaining on the system; so that the net revenue due to the branch lines was a great deal more than the £11,000 which the Southern Railway had to make up. From these figures the writer of the article infers that a main line might allow a rebate of 20 to 30 per cent. on all traffic contributed by a local line.

M. Colson*—in his report to the International Railway Congress of 1891—implies that, both in France and Belgium, light railways have been successfully launched, so far as their construction goes, but that their working leaves much to be desired.

Discussion on the Utility of Branch Lines.—The advocates of light railways will find in M. Considère's articles† on the utility of branch lines—and in M. Colson's criticisms‡—a most valuable demonstration of the claims which such lines have upon the main lines, the inhabitants of the locality traversed, and the community at large, for support and encouragement in return for direct and indirect benefits conferred by them. This is, indeed, the chief lesson to be learned in our study of the light railways question in France.

We are so accustomed to accept as a matter of course—disposed of with the payment of rates and fares—the direct advantages which we derive from railways, that few of us attempt to realise to what extent we are indirectly indebted to them. M. Considère has endeavoured (1) to show how largely the main lines profit, both directly and indirectly, from light railways which act as feeders to them, (2) how largely the public are benefited by them, (3) to prove that, if railways are to render the maximum of direct usefulness to the public, all rates should be reduced to the incremental cost of service (a term which will be defined later on), and (4) instead of guaranteeing a minimum interest on capital or handing over a certain proportion of the gross receipts, to evolve a traffic formula which will induce a working agency to earn its subsidy by the development of traffic, the reduction of rates, and the provision of a liberal train service.

Obtaining his data, first of all, from the special case of nine light feeder lines on the Western, Orleans, and Northern systems, and then, for further confirmation, from general statistics, M. Considère's investigations lead him to conclude that, for every franc of passenger receipts taken on the branch, the main line also takes one franc; that, for every franc of goods receipts taken on the branch, the main line takes two francs; and that, taking passengers and goods together, the branch contributes—on the average—to the main line additional receipts amounting to 140 per cent. of the receipts on the branch. In M. Colson's opinion, however, branch lines develop *local* traffic mainly, and their contributions to the main lines have been overestimated by M. Considère. Without attempting to determine to what precise extent main lines are indebted to branch lines, the late Mr A. M. Wellington described the position very clearly: *—"The reason for the continued and rapid building of branches in spite of their apparent unproductiveness is simply this:—They contribute traffic to the main line which, as it is merely an increment, *costs always comparatively little to move, and often nothing at all.*" If the contributed traffic takes the form of extra passengers or small consignments filling up vehicles which otherwise would be insufficiently loaded, if it supplies a back-load, and if it is carried on the main line in the direction of favouring grades, the main line's share of the receipts becomes practically an addition to its net—rather than to its gross—revenue. Light railways, therefore, when they act as feeders, are entitled to the most generous treatment at the hands of main line companies. The latter may do their shunting, marshalling, transhipment, and clerkage for them at junctions at a small charge or even (if these services involve no addition to the main line staff) for nothing; afford them the fullest junction facilities, platform, yard and shed space, etc.; repair their engines and rolling-stock at cost price; treat them leniently in regard to demurrage and detention of wagons; allow them, in the division of earnings, a share depending on the lead on the main line of traffic contributed by the branch, etc. Under the usual terms, hay might be consigned from Easingwold in Yorkshire to Hexham in Northumberland or only to a main line station just beyond the junction, and the branch would receive the same in either case.

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* *Bull. de la Comm. Intern. du Cong. des Chemins de Fer*, 1891,—"La Législation des Chemins de Fer Économiques."

† *Annales des Ponts et Chaussées*, vol. iii., 1892, and vol. vii., 1894.

‡ *Annales des Ponts et Chaussées*, Nov. 1892.

The direct gain, says M. Considère, to the actual users of railways —and this, he insists, is quite as true of light railways—is equal to half the gross receipts. The indirect gain to the country at large is equal to two and a half times the gross receipts. The total contribution of railways to the wealth of the country, directly and indirectly, amounts, therefore, to three times the gross receipts. Inasmuch as only one-third of the lead of traffic due to the branch lies on the branch itself, the direct and indirect gains to the public of such light railways is equal to six times the gross receipts. Their value to the State is equivalent to 5 per cent. per annum on their first cost. The State, says M. Considère, owes this to these local lines. The general taxpayer might, therefore, be fairly called upon to support them to that extent. On the other hand, the general taxpayer may—as will be seen further on in our epitome of M. Considère's views—require these lines to be worked at rates which approach the incremental cost of service, in order that he may get full value out of them. M. Colson doubts that light railways of local interest have any appreciable effect on the public wealth. Even that of the great railways must be shared with other agents of modern progress. The utmost we can expect from these light railways is one simple and tangible result—the cheaper carriage of certain commodities. Any attempt, says M. Colson, to count upon indirect benefits as a set-off to increased taxation must be regarded as too complicated a problem to be put into figures. In considering the feasibility of a light railway project, all we can do is, after a careful study of the nature of the traffic to be got in the district, to estimate, more or less correctly—(1) the probable receipts on the branch itself, (2) the additional receipts it will bring to the main line, and (3) the direct profit to the public on cost of transport. These direct benefits may be compared with the direct expenditure to be incurred, but there we must stop. The gross receipts are the most important item, and they should, M. Colson considers, not only cover the actual cost of working, but also pay interest on a portion of the capital. The remainder of the capital may justifiably be furnished by the State and the Department. Indeed, considering the privileges belonging to the State in regard to mails, telegraph, stamps, etc., it might contribute as much as one-half. M. Colson values highly the vivifying effect of railway passenger traffic.

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* *Economic Theory of Railway Location*, by A. M. Wellington.

If, says M. Considère, railways are to render the maximum of usefulness to the public, it may be necessary to reduce rates to the incremental cost of service (*le prix de revient partiel de transport*). The application of this term, which occurs so constantly in the discussions of French experts, must be explained. The legal or maximum tariff is divisible into two parts—(1) the toll (*droit de péage*), to cover the cost of maintenance of way and works and interest on capital, and (2) the charge for carriage (*prix de transport*) to cover movement expenses, including those connected with rolling-stock, the cost of hauling, and the cost of working the traffic. The toll amounts to about 60 per cent. of the whole charge. The actual cost of service (*prix de revient des transports*) is also made up of fixed and movement expenses. If from the cost of service we eliminate the quota of fixed charges falling, on division, to each unit of traffic, we arrive at the actual increment of cost (*le prix de revient partiel de transport*) due to the movement of a unit of traffic, and to this we will apply the term "incremental cost of service." The investigations of M. Baum and other experts justify generally the assumption that cost of service is about the same per passenger-mile and per ton-mile. In discussions on French railways, the cost of service is usually accepted as 5½ centimes per ton or passenger per kilometre (0·88d. per mile) and the incremental cost of service as 2 centimes per kilometre (0·32d. per mile). The cost of service may differ greatly on one railway and another. On one Indian railway the average cost of hauling a ton of goods is stated to be 0·14d. per mile, on another 0·7d. per mile. As between one kind of goods and another, the differences in cost of service must be far greater. The determination of the average cost of service would serve no practical purpose, but the use of the term has a definite value in discussion.

Obviously in regard to goods, the cost of service diminishes as we obtain fuller loads; when the amount of business done in a certain commodity is so large that the fixed charges, being widely distributed, tend to disappear; when return loads fill trains that otherwise would run empty; when the goods are easily handled; when the consignor and consignee do their own loading and unloading; when the grades and curves of the lines are easy; when the goods can be run through without break of bulk or transhipment, etc. Under such favourable conditions the incremental cost of service may be reduced from 2 to 1½ centimes per kilometre (from 0·32d. to 0·24d. per mile), as in the case of coal trained from the North of France to Paris.

M. Considère's proposition is opposed to all practical ideas of railway economics. The minimum rate—below which a reduction would bring no further traffic of the kind—may be determined by the consumption or by the production, the demand or the supply, of that commodity. Like the prohibitive maximum rate, it depends more upon the value of the goods than upon anything else. If, in order to reach the minimum, the incremental cost of service is barely covered, other goods which can afford to do so must pay the fixed charges, or the tax-payer must make up the deficit.

As a matter of fact, in French as in English practice, Solacroup's rule is followed of making the goods pay what they can afford to pay, and the classification depends mainly upon the value of the goods and the loss or damage for which the railway would be responsible. It has been left to Germany to abandon the *ad valorem* principle of rates and classification in favour of the so-called "natural system" (utterly condemned by M. Colson) of basing the charge on the weight and volume of the goods. A tradesman might just as well charge the same price per pound or per cubic inch for every article in his shop. This system ignored the question of varying responsibility; it gave rise to innumerable practical difficulties, and the endeavour to reduce the charges by closer loading—in full wagons, in groups of wagons, or in complete trains—created an intermediate service of middlemen called "groupers," who pocketed any nominal saving on the rates.

As we have said before, instead of expecting low rates on light railways, we must be prepared very often to pay as much as double the ordinary rates, and this has been already recognised in the schedules of the orders authorizing light railways in England under the Act of 1896.

In France, when the Departments determined to construct the light railways but to lease the working of them, various formulæ were from time to time proposed for expressing the amount of subsidy in terms which should ensure the mutual benefit of the public, the lessees, and the Department.

The tendency of a formula based on a division of net earnings would be to encourage the working agency to keep up the rates, and the necessity of checking the expenses would entail a blending of the official element in the management which would be objectionable.

Most of the Indian Government agreements with companies working the railways depend on a division of surplus profits (if any) after repayment of guaranteed interest, etc.

In France and Belgium it is usual to adopt formulæ based on a division of gross receipts. The effect of these may be to give the lessee too much on passengers or too little on goods which, although of great importance to the public, are only able to bear a low rate, and there is no inducement to run additional trains. The conflicting interests of the lessee and the public are aggravated, and the usefulness of the railway greatly impaired. A few examples may be given, expressed in English as well as French terms :—

Let F = the working subsidy in francs per kilometre.
L = " " pounds sterling per mile.
R = the gross receipts in francs or in pounds in each case; then—

$$\begin{array}{l|l}
F = 2250\text{f.} + \frac{1}{4}R & L = \pounds 145 + \frac{1}{4}R \\
F = 2000\text{f.} + \frac{1}{3}R & L = \pounds 129 + \frac{1}{3}R \\
F = 1500\text{f.} + \frac{1}{2}R & L = \pounds 97 + \frac{1}{2}R \\
F = 750\text{f.} + \frac{3}{4}R & L = \pounds 48 + \frac{3}{4}R
\end{array}$$

The constants in these formulæ are obviously such that the subsidy would be equal to the gross receipts, when the latter amounted to 3000 francs per kilometre or £193 per mile.

In those known as the Belgian formulæ—

$$\begin{array}{lll}
F = & R & (\text{if } R = 0 \text{ to } 2000\text{f.}) \\
F = & 1500\text{f.} + 0{\cdot}30\,R & (\text{if } R = 2000\text{f. to } 5000\text{f.}) \\
F = & 500\text{f.} + 0{\cdot}50\,R & (\text{if } R = 5000\text{f.} +) \\
L = & R & (\text{if } R = 0 \text{ to } \pounds 129) \\
L = & \pounds 97 + 0{\cdot}30\,R & (\text{if } R = \pounds 129 \text{ to } \pounds 322) \\
L = & \pounds 32 + 0{\cdot}50\,R & (\text{if } R = \pounds 322 +)
\end{array}$$

the singular assumption seems to be made that working expenses increase more rapidly when the gross receipts exceed 5000 francs per kilometre or £322 per mile, than when they are below that amount. Accordingly M. Noblemaire (of the P.-L.-M. Railway) proposed the following—

$$\begin{array}{lll}
F = & R & (\text{if } R = 0 \text{ to } 1000\text{f.}) \\
F = & 250\text{f.} + \frac{3}{4}R & (\text{if } R = 1000\text{f. to } 3000\text{f.}) \\
F = & 1000\text{f.} + \frac{1}{2}R & (\text{if } R = 3000\text{f. to } 5000\text{f.}) \\
F = & 2000\text{f.} + 0{\cdot}30\,R & (\text{if } R = 5000\text{f.} +) \\
L = & R & (\text{if } R = 0 \text{ to } \pounds 64) \\
L = & \pounds 16 + \frac{3}{4}R & (\text{if } R = \pounds 64 + \pounds 193) \\
L = & \pounds 64 + \frac{1}{2}R & (\text{if } R = \pounds 193 + \pounds 322) \\
L = & \pounds 129 + 0{\cdot}30\,R & (\text{if } R = \pounds 322 +)
\end{array}$$

The different results obtained by the use of one series or the other is sufficiently illustrated by a few figures.

R	Belgian F	Noblemaire's F	R	Belgian F	Noblemaire's F
f.	f.	f.	f.	f.	f.
1,000	1,000	1,000	6,000	3,500	3,800
1,500	1,500	1,375	8,000	4,500	4,400
2,500	2,250	2,125	10,000	5,500	5,000
4,000	2,700	3,000	12,000	6,500	5,600

In some cases the Government of India has undertaken to maintain, stock, and work a railway constructed by a company for so much per cent. of the gross earnings, and has allowed to the company, by way of rebate on the net earnings of the State railway, from traffic interchanged with the company's line, a certain amount, as required, to make up interest at a certain rate on the actual capital expenditure, surplus profits in excess of a certain percentage on capital being divisible between the State and the company.

M. Considère, discarding all formulæ based merely on gross receipts, first of all reduces the complicated formula adopted in Le Finistère to four terms:—

$$F = a + bR^V + cR^M + eM^K,$$

where R^V = gross receipts from passengers, R^M = gross receipts from goods, and M^K = the number of goods tonnes-kilometres (corresponding with our ton-mileage), and then expands it into six terms—

$$F = a + bR^V + cR^M + dV^K + eM^K + fK,$$

where V^K = the number of passenger-kilometres, and K train-kilometres. The co-efficients he proposes as follows—

$$F = 1000\text{f.} + 0{\cdot}15R^V + 0{\cdot}25R^M + 0{\cdot}04V^K + 0{\cdot}012M^K + 0{\cdot}40K,$$

or, as we might write it in English equivalents—

$$L = £64 + 0{\cdot}15R^P + 0{\cdot}25R^G + 0{\cdot}04P^M + 0{\cdot}012G^M + 0{\cdot}40M.$$

The effect of the first three terms is obvious. They give the lessee a fixed sum *plus* a certain proportion of the gross receipts from passengers and goods. The fourth and fifth terms encourage him to increase his passenger-mileage and goods ton-mileage. The sixth term induces him, not merely to run the service of trains required in the specification, but to put on additional trains for goods or passengers when the public convenience demands them. The co-efficients may, of course, be modified according to the conditions of traffic.

M. Colson agrees with M. Considère that a good working formula is urgently needed for leasing lines of low traffic—especially those which have been assisted from the public purse—and concurs in his rejection of formulæ of the $a + bR$ type. M. Considère's solution of the problem receives from him a warm tribute of praise, but he suggests certain modifications in the formula. He would combine the goods and passenger receipts in one term, R. Moreover, M. Considère's co-efficients tend to lower the rates too much, because the lessee is not sufficiently interested in increased receipts, and might even find it pay him to carry certain traffic for nothing. An additional train with 60 tons of goods, for example, would add to his subsidy (under the fifth and sixth terms) 1·12 francs, even if the receipts were *nil*. M. Colson, therefore, would increase the effect of R, and reduce that of a, M, and K, thus:—

$$F = 300f + 0{\cdot}5R + 0{\cdot}005M + 0{\cdot}3K,$$

or expressed in English equivalents—

$$L = £19 + 0{\cdot}5R + 0{\cdot}005G + 0{\cdot}3M.$$

M. Colson is of opinion that, by way of security, the lessee should provide part of the capital, and, if the lessee had advanced as much as 10,000 francs per kilometre, or £644 per mile, the constant might be raised to 700 francs in one formula and £45 in the other, to give the lessee 4 per cent. on his share of the capital. It will be observed that if the lessee now runs an additional goods train of 60 tons, the third and fourth terms will only give him 60 centimes for it, so that he is obliged to keep his rates high enough to make R a remunerative item, especially if new stock has to be built for the new traffic.

A formula of the type advocated by MM. Considère and Colson has actually been applied to two light railways in the Department of the Loire, and in quoting it from an interesting summary* of an article on "State Subsidies" in the *Voie Ferrée*, only the letters and order of the terms have been changed for the purpose of comparison—

$$L = £93 + 0{\cdot}3R + 3d.G + \tfrac{1}{4}d.M.$$

in English equivalents.

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* *Transport*, Nov. 23 1894

CHAPTER V.

LIGHT RAILWAYS IN ITALY.

CONTENTS.—Railways in each small State—Unification of Italy and purchase of railways by Government—Their operation by companies—The law of 1873—Secondary lines under the law of 1879—The laws of 1881, 1887, and 1889—Remarkable development of tramways—Relative position of light railways and tramways—Various gauges—Signor Adamoli's report—Attitude of the great lines towards light railways—Palermo-Corleone light railway—Steam tramways—Occupation of roads by light lines.

Relation of Government to the Main Railways.—In Germany, as will be observed in the next chapter, the first railways were built for the local purposes of the different States, and very much the same thing occurred in Italy. With the unification of Italy—which began with the annexation of Lombardy to Sardinia in 1859, and was finally accomplished by the absorption of the Pontifical States in 1871—came the closer connection of the various railways. In the course of a few years they were bought up by the State, and in 1885, State management having been tried and found wanting, the working of the railways was leased to great companies on a system of division based upon the gross receipts—a system which may induce the agency to cut down expenses on renewals and improvements, but is not likely to make it prefer a large traffic at low rates to a small traffic at high rates. Such, briefly, is the position of the main lines, and more need not here be said before introducing the subject of minor lines.

Laws Relative to the Minor Railways.—Under the law of 1873 a certain number of railways were constructed under special conditions of economy and encouragement, such as their exemption from taxes on materials of construction, their freedom from the usual requirements in regard to continuous fencing, their promotion by provincial or communal syndicates, their assistance with an annual subsidy of £64 per mile (1000 francs per kilometre) for thirty-five years, etc. This, for example, was the subsidy given to the Torrebelvicino-Schio-Arsiero line (3′ 1½″ gauge) 14 miles long, to which, however, no corporate bodies appear to have contributed.*

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* *Reports from Her Majesty's Representatives Abroad on Light Railways*, 1894.—Italy, No. 6.

The Railway Classification Law of 1879 authorised the State to construct 951 miles (1530 kilometres) of secondary lines, on condition that district syndicates furnished 40 per cent. of the cost up to £5150 per mile (80,000 francs per kilometre), 30 per cent. of the next £4506 per mile (70,000 per kilometre), and 10 per cent. of anything above that amount. Accordingly, the Arezzo-Fossato line ($3' 3\frac{3}{8}''$ gauge), 83 miles long, received $\frac{6}{10}$ths as State subsidy, and $\frac{4}{10}$ths as contributions from corporations. The conditions and subsidies of the law of 1873 were extended to such lines, the adoption of narrow gauges was permitted, and these railways might be built on the public roads, provided that a clear width of $16' 4\frac{3}{4}''$ (5 metres) was left for cart traffic.

The law of 1881 permitted the State to afford assistance by subsidies to other lines besides those covered by the law of 1873. The maximum of these subsidies was raised, by the law of 1887, from £64 to £193 per mile (3000 francs per kilometre), and the term of concession was prolonged from thirty-five to seventy years. Such a subsidy was granted to the Biellese lines ($3' 1\frac{1}{2}''$ gauge), 24 miles long, to which the corporations interested also contributed a lump sum of £10,000 (250,000 lire). The law of 1889 extended aid by State subsidies to lines promoted by private parties in their own interests.

Development of Tramways.—But in Italy, as in the Netherlands, the development of *tramways* (by which are meant railways laid on roads) has been much more remarkable than that of secondary railways. Failing a special law dealing with tramways, their position is to some extent defined and recognised by various orders issued by the Public Works Department and the Council of State, as well as by legal decisions. Thus a tramway cannot be laid on a road except with the sanction of the road authorities. Higher authority cannot override lower authority which maintains part of the roads to be occupied. The tramway must not interfere with ordinary road traffic; as soon as carts and carriages cannot use the top of the tramway the line becomes a railway. The road authorities surrender no part in the possession of the roads to the tramways; if the roads, to suit the tramways, require improvement or alteration, the road authorities execute this themselves. The spread of tramways in Italy is, as M. Colson indicates in his "Exposé de la Question de la Législation des Chemins de Fer Économiques,"* largely due to their freedom from restrictions, and their decentralisation.

Railway legislation does not hamper tramways. They come under legislation affecting steam engines, however, and in this way the Minister of Public Works has been able to regulate sufficiently tramway construction and working. Thus there may not be more than 4, 5, or 6 vehicles on a train; maximum speed may be fixed at anything between $9\frac{1}{3}$ and $15\frac{1}{2}$ miles (14 to 25 kilometres) an hour, 11 miles (18 kilometres) being the usual maximum; at certain places the trains may be restricted to a foot pace; occasionally the platelayers

* *Bull. de la Comm. Internat. du Cong. des Chemins de Fer*, 1891.

may have to line the road from point to point, but a troublesome and costly requirement of this kind is seldom enforced. In regard to the tariff, a most important matter, the working agencies are allowed a very free hand, no maxima even, in some cases, being prescribed.

Tramways do not seem to receive large subsidies. They may be compelled to carry the mails free, but, being classed as road undertakings, they escape the taxes which weigh so heavily upon the railways.

Relative Position of Light Railways and Tramways.—It was anticipated by M. Colson that a law, which had for some years been in contemplation, would be passed by the Italian Parliament, depriving tramways of all the advantages due to their decentralisation, bringing them, like the light railways, under central control, and placing them under almost as stringent conditions as the normal railways. In the case of tramways the clearance between the vehicles and houses fronting the side of the line was to be fixed at 2 ft. 7½ in. (0·80 metre). The speed was not to exceed 15 miles (24 kilometres) an hour by day, and 11 miles (18 kilometres) by night. If the maximum speed did not exceed 12½ miles (20 kilometres) an hour, the line was to be exempted from payment of the fast-train tax, and only liable to the usual 2 per cent. levied on freight carried by slow trains; but the other lines would be taxed like the normal railways. The five centimes stamp duty on tickets, however, was not to be exacted for shorter distances than 6¼ miles (10 kilometres). Direct management by the Departments and Communes was to be prohibited. The concession was to terminate at the end of forty years as a maximum limit. Maximum rates and fares would be fixed by the Government, who would reserve entire control of the working.

Light railways would be dealt with under the same law. Concessions for these would be granted by the State, even when they were to be laid wholly or partly upon ordinary roads, but this occupation would require the consent of the local authorities. The maximum term of such concessions would be seventy years, or, if three-fourths of a line lay on the roads, fifty years only. Special regulations would be included in the act of concession regarding the working of the line, the rolling-stock, the composition of the trains, and their speed, which was to be limited to 18½ miles (30 kilometres) an hour in the case of railways using the roads. The part of the road occupied by the railway was not to be used by carts, carriages, or foot-passengers, but was to be marked off so as to leave a clear width of road of at least 16 ft. 4¾ in. (5 metres). These lines were to be freed from the stringent regulations regarding fencing, gates, gate-lodges, etc., which are applied to ordinary railways. Secondary railways were to be allowed the reduction, granted in 1885 to the great lines, of the tax on passengers on urban and suburban journeys, to 2 per cent. Stamp duties on tickets were to be retained. The State would reserve full control of the working, and prescribe the time-table.

The proposed law would authorise the Government to subsidise the lines in terms of the law of 1889, and require the districts and persons interested to furnish similar assistance, in the form of annuities to date from the opening of the lines for traffic.

If the law passed, the classification of existing lines as tramways or as light railways would come under the consideration of the Government, and concessionnaires were greatly alarmed at the prospect of their tramways being reclassed as railways, and burdened with additional taxation accordingly. The proposed law would be a complete reversal of the policy of decentralisation which had been so favourable to these lines; and would bring the tramways under the same regulations as applied to light railways, which—as M. Colson said—differed but little from those imposed on the great lines.

Light Railways.—We find various gauges on the light railways—2′ 9½″, 3′ 1½″, 3′ 3⅜″, and 3′ 7¼″ (0·85, 0·95, 1, and 1·10 metre), and also on the tramways—2′ 5½″, 3′ 0½″, 3′ 3⅜″, 3′ 7¼″, and 4′ 8½″ (0·75, 0·95, 1, 1·10, and 1·435 metre).

According to Signor G. Adamoli,* the Naples-Nala-Baiano received no contribution either from State or corporation, but is a very paying concern. All the others (except the Turin-Rivoli line to which the Province of Turin contributed), received a subsidy from the State. Most received assistance from interested corporations as well.

The tramways, constructed and worked at the expense of the concessionnaires, are not obliged to furnish such returns as would indicate what profit they make.

While unable to give figures relating to the increase in trade and produce due to light lines, Signor Adamoli observes:—"The fact, however, that none of the grantees has been under the necessity of suspending or giving up the undertaking, and that none of these lines has afforded the least reason to suppose that, owing to absence of profits, it may be eventually closed, leads to the conclusion that such railways have yielded good results to the localities traversed, and those who have constructed them."

Yet M. de Bäcker, in his report† on the relations between the great railways and light feeder lines, tells us that those light lines suffer grievously at the hands of two great systems of main railways, bought up by the State and leased in 1885, for a term of sixty years, to two powerful working companies (the Adriatic and the Mediterranean). When those leases were made out, the great railways were expected to do wonders for the wealth and prosperity of the country. As these anticipations failed, so the great railways became suspicious of competition and injury everywhere. On the contrary, it is argued, the effect of these light lines has been contributive, not (or in but few cases) competitive. Yet, even those light lines which act as branches and feeders are said to be treated by the main lines in most stepmotherly fashion. They are looked upon as mere underlings, and the assistance afforded them takes such doubtful forms as through booking, a burden rather than a privilege, a facility given to the public and accompanied by a reduction of fixed charges; the loss falls mainly upon the poor light line, which has to do the junction work covered by those fixed charges; and, while the latter are comparatively unimportant on long-distance traffic, their loss easily swallows up the short-lead share of a through rate which is allotted to the branch. Interchange of rolling-stock and through rating, as between two great lines, are all very well, but the provision of suitable rolling-stock by the small line is a heavy expense, while the performance of shunting, marshalling, transhipment, haulage, etc., at the entire expense of the branch is indefensible.

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* *Reports from Her Majesty's Representatives abroad on Light Railways*, 1894.

† *Bull. de la Comm. Internat. du Cong. des Chemins de Fer*, 1895.

The Palermo-Corleone Railway in Sicily is a light line on the 3′ 1½″ gauge, 42 miles (68 kilometres) long, to the capital of which (according to Mr Adamoli's Report) the State contributed 60, and the corporations 40 per cent. Interesting details of this line are given by Mr R. J. Money,* some of which may be quoted:—

Width at formation level, 11′ 6″.
Steel flange rail, 40 lbs. per yard.
Red oak sleepers, 5′ 6″ by 7 in. by 4½ in.
Minimum depth of ballast under sleepers, 4 in.
Running time, 42 miles, including stops, 3 hours 50 minutes = 9⅓ miles per hour.
Running time, 42 miles, excluding stops, 3 hours 27 minutes = 11 miles per hour.

Metal bed-plates were laid between rail and sleeper at joints and throughout sharp curves, and their number has since been increased; the plates are pierced for two spikes.

The first and second class carriages (each with 16 seats longitudinally) and the luggage-vans weigh 3 tons empty and 7 tons full. The four-wheeled wagons weigh 3 tons empty, 9 tons loaded to full capacity, and 6 tons loaded with general goods: the corresponding weights for bogie-wagons are 6, 18, and 9 tons respectively. Thus, two four-wheel wagons, with 6 tons dead weight, will carry 12 tons of general goods against only 9 tons of general goods carried by one bogie-wagon, with the same dead weight. Mr Money does not refer to this difference of capacity, but he points out that on curves the tractive power required to haul three four-wheel wagons will haul two bogie-wagons, which is, of course, in favour of the latter.

It appears that the engine-loads, with three axles coupled, vary from 45 or 50 tons on a maximum gradient of 3·9 per cent. to 100 or 105 tons on the level.

Tank-engines are used, diameter of cylinders, 12½ in.; stroke, 18 in.; axles, 3 coupled, 1 pony; rigid wheel-base, 6 ft.; diameter of wheels, 2′ 10½″ and 2 ft.; heating surface, 495 sq. ft.; weight, loaded, 24 tons 6 cwt.; greatest axle-load, 6 tons 4 cwt.; gross load hauled up maximum incline of 1 in 25, 50 tons; builders, Messrs Hawthorn, Leslie, & Co.

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* "Light Railways," by Mr R. J. Money, *Min. Proc. Inst. C.E.*, vol. cxxiv.

Mr Money gives figures also for the standard-gauge main line Sicilian Railway, some of which may be arranged, so far as possible, for comparison :—

Details.	Sicilian Railways Main Lines.	Palermo-Corleone Railway.
Length of line on level, ...	20 per cent.	12 per cent.
,, ,, ,, gradient of 1 in 200 or less,	20 ,,	14 ,,
,, ,, ,, ,, 1 in 66, .	39 ,,	14 ,,
,, ,, ,, ,, over 1 in 66, .	21 ,,	60 ,,
Length of straight line, ...	50 per cent.	55 per cent.
Curved line, over 500 metres (1640 feet) radius, .	20 ,,	14 ,,
,, ,, 500 metres radius or less, . .	30 ,,	42 ,,
Maximum gradient, ...	1 in 31·5	1 in 25·6
Minimum radius of curves, ...	492 feet	230 feet

On the main lines, the allowance of coal was 0·27 kilogramme per axle-kilometre, with 30 kilogrammes extra to locomotives hauling express trains. Each hour standing in steam was equivalent to 2 locomotive-kilometres, and each hour shunting trains to 5 train-kilometres.

On the Palermo-Corleone light line the allowance of coal was for each:

	Kilogrammes.
Locomotive-kilometre, ...	4·00
Hour in reserve shunting, ...	30·00
Hour standing in steam without shunting, . .	15·00
Lighting up, ...	60·00
Carriage-kilometre, ...	0·60
Loaded wagon (2 axles) kilometre, . . .	0·70
,, ,, (4 axles) ,, ...	1·40
Empty wagon (2 axles) ,, ...	0·35
,, ,, (4 axles) ,, ...	0·70

Hour shunting = 4 locomotive-kilometres.

Women, at a monthly salary of only 5s. to 9s., protect the level-crossings and signal the trains on the Palermo-Corleone line.

For the first four miles from Palermo the railway runs alongside, and on a level with the highway, separated only by a low stone wall, 9 to 15 inches high, serving rather as a boundary and to hold the ballast than to protect the road traffic. "Although," says Mr Money, "there is considerable traffic on the highway, both in carts and foot passengers, no difficulty is experienced in working the railway on these four miles." Nor is there any difficulty on the Wisbech and Upwell Railway in Cambridgeshire, on many light lines in India which run through crowded bazaars, nor on the Italian roads occupied by tramways, and one would think Mr Money's remark unnecessary were it not for the opposite view held by many of the British public.

Steam Tramways.—Of "steam tramways in Italy"—as distinguished from such light railways as we have just been discussing—Signor P. Amoretti has given us an interesting description.*

There is quite a cluster of these about such centres as Padua, Mantua, Bologna, Piacenza, Turin, and especially Milan. Altogether, there were about 1875 miles of steam tramways in Italy in 1895, and most of them, according to Signor Amoretti, were on the standard 4′ 8½″ gauge. On the other hand, it is puzzling to find in Signor Adamoli's list only one standard gauge tramway (the Naples-Puzzuoli Tramway), and only 287 miles (461·744 kilometres) of tramways altogether. Evidently the term has been differently applied by each of these gentlemen; difficulties of this kind are constantly cropping up in the study of light railways.

A remarkable development of lines, originally local and isolated, into a connected system, with through and cumulative working, has taken place in many parts, especially in Lombardy. In some cases goods can be carried right through by tramway, without transfer, for more than 100 miles. On the tramways around Pisa, and on others, railway wagons are freely worked. About 36 companies, operating 1365 miles of tramways, form the Italian Tramway Association.

Of narrow gauges adopted on the tramways, the following were mentioned a few pages back, having been gathered from Signor Adamoli's list—2′ 5½″, 3′ 0½″, 3′ 3⅜″, and 3′ 7¼″. Only the first and last of these are given by Signor Amoretti, who also mentions a 2′ 11½″ gauge as being used.

It is absolutely necessary that the top of the rail be flush with the surface of the road; but, in many cases, the metalling between the rails is only rough-dressed, so that, although there is nothing to prevent ordinary carts from passing over the tramway, if necessary, there is no inducement for them to remain on it longer than they are obliged. When the road is as wide as 32′ 10″, the line is separated, or rather marked off, from the road by spurstones at intervals, which give a clear carriage or cart-way (to spurstones on the opposite side) of 19′ 8″. On roads of minimum width, 26′ 3″, the line is not separated by spurstones, and the clear space (from inner rail to spurstone on the opposite side) is only 16′ 5″. On the narrower roads, according to Mr Robert Gordon,† the Milanese tramways sometimes follow the centre, and share it with ordinary cart traffic. On bridges, between parapets, the minimum distance is 23′ 11½″, which gives also a clear space of 16′ 5″. In streets, the line is, as a rule, laid in the middle, but in narrower places the line must be laid on the side to leave a minimum clearance to the other side of 15′ 9″.

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* *Min. Proc. Inst. C.E.*, vol. cxix., 1895; also in *The Engineer*, March and April 1895.

† *Min. Proc. Inst. C.E.*, vol. lxxix., Parsons on "Tramways."

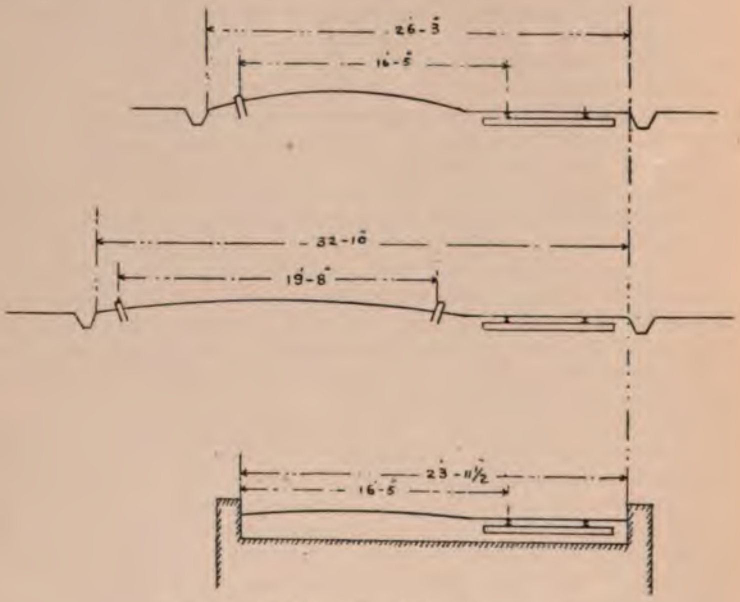

FIG. 2.—Road Sections, Italian Tramways.

Vignoles or flat-footed rails are exclusively used. They are spiked directly to the sleeper on the straights, but chairs (or rather, it may be presumed, flat bearing-plates) are inserted on curves. The 36 lb. rail has a very narrow head; the 42 lb. rail is a wider pattern. Only where it is necessary to cross a road, and in towns, are guard-rails used to facilitate consolidation of the road-metal for the passage of ordinary carts. Oak sleepers are used, as this wood is plentiful; their dimensions are 7′ 3″ by 7 in. by 4¼ in. Guard-rails, of similar section to the running rail, are used on curves of less than 165 ft. radius. The cost of permanent-way, with a 40 lb. rail, was said by Mr Churchward in 1885* to be about 15s. per lineal yard. In the towns, point levers are fitted in a box flush with the ground, and can be actuated by the foot pressing down a counterspring. The curves are frequently very sharp indeed, and gradients are sometimes as heavy as 1 in 15. It is acknowledged that such gradients restrict the utility of the line, more especially for goods traffic, but the object seems to be to construct the line, even with such drawbacks. The crossing places have a loop siding on the off side, requiring an extra strip of land; the greatest length of trains is not much more than 130 ft., so that 359 ft. from points to points gives ample room for crossing, coupling, uncoupling, or other shunting purposes. Occasionally a dead end is required as well. So far as possible, these crossing stations are laid on public ground, as the tramway companies have no powers to take up land compulsorily. The station may consist simply of a signboard with the inscription "stopping place," except at termini. The connections with private sidings—leading directly to farms, fruit gardens, dairies, mills, factories, ironworks, brickworks, limekilns, quarries, and mines—are numerous, and are such as would be "unattainable on such a general scale by ordinary railways."

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* *Min. Proc. Inst. C.E.*, vol. lxxix., Parsons on "Tramways."

"The development of this important branch of traffic resources" —says Signor Amoretti, and the paragraph deserves *verbatim* quotation—"has induced the various companies to do their utmost to facilitate loading and unloading processes. Thus, for instance, for the conveyance of bricks and tiles from the extensive works at Beivasco to Turin, the trucks are simple platforms, carrying three or four open cages, in which the bricks or tiles are stacked straight from the field. On arrival at Turin the cages are slung off by a crane on to carts, and thus conveyed to their destination without one intermediate process of handling, thus avoiding cumulative charges and attendant percentage of damage. Another special class of work is the conveyance of fæcal matter from Milan to outlying sewage farms. The matter is removed in the first place in iron tanks on ordinary carts to the tramway station, where the tanks are slung by the crane on to platform trucks. At their destination the tanks are either emptied direct into a large reservoir or conveyed on carts to the fields. . . . . These arrangements are undoubtedly of great importance to agricultural districts, and permit of the disposal, at the cheapest possible rate, of sewage matter to much greater distances from the city or town than would otherwise be possible by costly work or machinery."

The engines have generally two axles; on exceptionally steep gradients three. The working parts are boxed with a casing which hangs to within 4 in. of the rail level. In full working order, the engines weigh 8, 16, or, exceptionally, 20 tons. The average distance from axle to axle is 5′ 3″, and the diameter of the wheels 1′ 11″ or 2′ 2¼″. Neither condensers nor smoke consumers are adopted. Coal is burned, and wire spark-guards are fitted on the chimney.

"Goods trucks generally resemble those used on the railways, their capacity ranging from 6 tons to 8 tons, and their weight (empty) varying from 2½ tons to 3½ tons for open trucks, and from 3½ tons to 4½ tons for covered vans."

All the passenger carriages, and most of the goods wagons, have brakes, chain brakes on the former, screw brakes on the latter. Continuous brakes are seldom adopted.

Tram trains running at from 10 to 12 miles an hour may have six vehicles attached to the engine. A maximum speed of 11, 12, and even 15 miles is permitted. The first-class fare is about 1d., and the second-class about ⅔d. per mile. At least one telegraphic connection is compulsory between all stations and stopping places along the line. The rates for goods are very low.

The average cost of tramway per mile may be put roughly at £2600, of which £500 is for rolling-stock. The gross earnings are about £400, the expenses £300 (or 75 per cent.), the net earnings, therefore, £100 per mile, and the average dividends (*i.e.*, on ordinary shares) about 3 per cent.

In his report to the International Railway Congress of 1891,* M. Colson recognises the use that has been made in Italy of the public roads, and he attributes the prosperity—as he describes it—of the light railways in Italy to the fact that they have not been legislated for, and have not been assisted to a very great extent, since private enterprise has thus had a free field, rates and service have been adapted to actual requirements, and minimum charges and maximum receipts have followed the natural laws of supply and demand.

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* *Bull. de la Comm. Intern. du Cong. des Chemins de Fer*, 1891.—"La Législation des Chemins de Fer Économiques."

CHAPTER VI.

LIGHT RAILWAYS IN OTHER EUROPEAN COUNTRIES.

(GERMANY, AUSTRIA, HUNGARY, HOLLAND, SWITZERLAND, SWEDEN, AND RUSSIA.)

Germany—Railways local and owned by each State—National interests paramount in Prussia alone—Imperial control of other States limited—Imperial edicts of 1875 and 1878 dealing with local railways—Secondary railways—Local railways on roads—Light railways in Prussia—Law of 1892 and State aid—Provincial and communal aid—Gauges of light railways—Cost—Capital—Development of town to town communication—Financial results—Details of economical working—Light railways beneficial to agriculture.

Austria—State ownership—Development of light railways under laws of 1880 and 1887—Facilities afforded by Diets of Styria, Bohemia, and Galicia—2 ft. 6 in. gauge in Bosnia and Herzegovina—Main features of light railway encouragement in Austro-Hungary.

Hungary—Local railways introduced in 1860—Facilities afforded by laws of 1880 and 1887—Brake-power—Statistics—Mr Milbanke's report.

Holland—Partial or total exemption of light railways from law of 1875—Facilities afforded by law of 1878—Light railways constructed by companies and worked by main-line companies—Carry main-line wagons—Gelderland-Overijssel System—Some worked by Dutch Railway Company on terms of lease or partnership—Development of light railways most prominent under form of tramways—Their freedom from restrictions and liberal treatment by road-owners—Capital mainly contributed by private subscribers.

Switzerland—Recently renewed interest in the movement—Description of the Genevese metre-gauge light lines—Main-line assistance.

Sweden—Annual allotments by the Diet for advances to companies—Facilities afforded by Swedish State railways—Narrow gauges.

Russia—Major lines of communication still wanting—Nevertheless minor lines legislated for in 1887—Encouraged by the State—Well treated by main lines.

GERMANY.

As, until the Confederation was dissolved in 1866, Germany consisted of numerous States, practically independent in the management of their internal affairs, it is not surprising to find that the early development of railways had no relation to Germany as a whole, but was carried on by each State separately, in accordance with its own particular requirements. The smaller States, adopting the policy of State ownership, "actually succeeded," says Prof. Hadley,* "in doing what so many of our country towns (in America) tried to do a few years ago by municipal subscriptions; that is, they secured *rail-*

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* *Railroad Transportation*, p. 204.

road construction for the sake of local interests, where mere business considerations would not have caused railroads to be built."

In Prussia, however, the growth of the national spirit was impressed upon the development of railways from the beginning. In 1842 State aid was granted in the form of guaranteed interest, and the right of taking over the railways after a certain number of years was reserved. In 1848 the State constructed a railway from Berlin towards the Russian frontier, largely for military reasons. Henceforward, the State continued to build lines on its own account, and to buy up railway stock. When, in 1870, Prussia welded all the German States (except Austria) into a solid empire, it was Bismarck's desire to establish an Imperial State railway system. This was resisted by the component States of the Empire; but, so far as Prussia itself is concerned, it presents to-day—as Prof. Hadley says—"the typical example of State railroad ownership." Most Prussian railway servants are members of the civil service, and the railway system has been organised as much for political and military, as for business, purposes. Moreover, Alsace-Lorraine, having no separate existence as a State, comes directly under the control of the Imperial Government.

So far as the railways of each of the other States are concerned, the Imperial Government confines itself to matters of general regulation and supervision. The former do not affect those lines which come under the edict of 1878, dealing with local railways. This edict recognises standard gauges of 4′ 8½″, 3′ 3⅜″, and 2′ 5½″ (1·435, 1, and 0·75 metre); limits the maximum speed of trains to 18½ miles (30 kilometres) an hour; imposes less severe regulations in regard to road inspection, fencing, signalling, train service, brake-power, &c.; and authorises local bodies still further to relax such rules, if necessary, with the approval of the Imperial Government. Under the law of 1875, these light railways either receive remuneration for the carriage of the Imperial mails—a service which the great lines have to perform gratis—or are altogether relieved of this duty.

Prussian, as distinguished from Imperial legislation dealing with secondary railways, deserves special attention. The Prussian Government in 1879 acknowledged generally that secondary lines required financial assistance and the application of less stringent rules of working, but declined to lay down more precise rules in the form of a rigid law. During the next ten or twelve years several secondary lines were constructed under concessions, but more (and these, as a rule, on the 4′ 8½″ gauge) by the State, which was also busily employed in the acquisition of all the railways. The same thing happened in regard to secondary railways in other German States. Secondary railways (*Nebenbahnen*)—it should be explained—are lines on the same gauge, and laid with the same description of permanent-way as the main lines, but the maximum speed is limited to (40 kilometres or) 25 miles an hour.

When, as was seldom the case in Germany, lines were laid on public roads, their treatment was less concerned with concessions than with the simpler regulations then permissible under the local authorities. In Bavaria such tramways formed part of the ordinary railway system. So also did they in Prussia, unless they lay entirely within the boundaries of one Commune, when the State did not interfere.

Light railways (*Kleinbahnen*) in Prussia are more particularly defined and regulated by the law which came into force on 1st October 1892, but no similar law has been introduced into the other States. At that time there were in Prussia 83 light railways, 69 of them being for passengers (and of these no less than 61 lay on the outskirts of towns), 5 for goods traffic, and 9 for mixed traffic. The standard gauge was adopted on 37, the metre on 35, the 2′ 5½″ on 3, the 1′ 10½″ on 1, and various other gauges on the remainder. The motive power used was locomotives on 25, electricity on 6, cable on 2, horses on 46, and mixed on others.* Within four years—*i.e.*, up to 30th September 1896—no less than 129 new light railways had been sanctioned under the law of 1892. Of these, 76 were in actual use, and 53 were in progress.

The new law places the light railways under the control of the Post and Telegraph Department, which finds them extremely useful. Financial assistance afforded by the State, the Provinces, and the Communes, in the interests of agriculture and forestry, has caused a rapid development of such lines. The State is empowered to lend £650,000 for this purpose. Up to the end of January 1897, £126,828 had been allotted, and it was intended shortly to increase the amount to £353,053, which would provide for the construction of about 633 miles of light railway. There appears to be a great variety in the form and the extent of the assistance given by the Provincial and Communal Authorities.

"The one point of agreement," says Lord Granville,† "seems to be that the Provincial and District Authorities never themselves undertake the construction of a light railway, but only support such undertakings on the part of other public bodies or private persons."

There are three principal methods in which such assistance is given:—

"1. In East Prussia, Hanover, Rhine Province, and the Department of Wiesbaden the preliminary works (earthworks, etc.) are carried out by the Province on the condition that the projectors bind themselves to repay half the expenses, or on other conditions.

"2. Direct financial assistance, which is itself given in four different ways:

"(*a*) Hanover, Saxony, Rhine Province, and Schleswig-Holstein grant a loan.

"In Hanover two-thirds of the total capital can be lent at 3 per cent. of interest, on condition that at least ½ per cent. is put by annually as a sinking fund, the interest always remaining the same.

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* *Min. Proc. Inst. C.E.*, vol. cxxxi., 1898,—Abstract on "The Development of Light Railways in Prussia."

† *Reports from Her Majesty's Representatives Abroad on Light Railways*, No. 9, 1894.

If the concern yields a net profit, it has to be paid in to the Province to raise the rate of interest or that of the sinking fund.

"Saxony lends capital to districts and companies according to the advice of the Provincial Committee.

"The Rhine Province lends the whole capital at 3 per cent. interest and ½ per cent. for sinking fund, on condition that any net profit shall be employed to raise the rate of interest to 3½ per cent., and then to raise the sinking fund.

"Schleswig-Holstein lends one-fourth of the original costs, exclusive of the acquisition of the land, without interest, but on condition of a sinking fund being raised.

"Westphalia empowers its Committee to lend capital without laying down any specified conditions.

"(*b*) East Prussia pays a certain part (not exceeding 1½ per cent.) of the interest paid by the contractors on the actually employed capital, but this is not to be paid for more than forty-three years, and the total amount yearly laid out by the Province for this purpose is not to exceed £750.

"Saxony undertakes to pay up to 4 per cent. for interest and sinking fund on condition that the Province shall rank before all other shareholders.

"(*c*) Silesia grants assistance in the form of a free contribution, to which no condition is attached, except that it shall be repaid if the profits of the railway are sufficient.

"Schleswig-Holstein, besides the above-mentioned loan, grants a free contribution up to one-eighth of the original cost, on condition that, if the concern is sold, the contribution shall be repaid with the same proportionate part of the sale money.

"Posen and Westphalia also intend to grant contributions, but have laid down no conditions.

"(*d*) Pomerania, Brandenburg, Posen, Westphalia, and the Department of Wiesbaden take shares in the undertaking.

"Most of the Provinces lay down as a condition of their help that the district authorities shall in some way be answerable for the railway.

"3. Facilities for the use of the public ways.

"Brandenburg allows free use of the public roads to light railways of a generally useful character. Saxony to all such undertakings.

"The Rhine Province only demands payment for the use of the public roads when the light railway pays a net profit of over 6 per cent., and then it demands payment of 20 per cent. of this surplus.

"East Prussia does not exact payment for the use of already existing roads, and even in other cases the payment can often be evaded. This is the same in Posen.

"In the budget for the Royal Domains and Forests for this year, £12,500 were set aside for the construction of light railways, and for subsidising the same, so far as these railways are of material interest to the domains and forests, but would not come into existence without the help of the latter. From this fund, up to the present time, five light railways have been subsidised in the Provinces of East Prussia and Pomerania."

With this memorandum of Lord Granville's is given a list of thirty-seven light railways only existing in 1894, and covering 480 miles, for he has not included those narrow-gauge lines which are legally treated as ordinary railways, although they might fairly be classed as light railways. They were evidently included in the figures given above for 1892.

In this list are found gauges of 4 ft. 8½ in., 1 metre, 2 ft. 11½ in., 2 ft. 7 in., 2 ft. 4¼ in., and 1 ft. 11¾ in. Of the narrowest gauge we have the greatest mileage, of the widest gauge the greatest number of lines. For narrower gauges than the standard, the Prussian law of 1892 recommended the metre, the 0·75 metre (2 ft. 5½ in.), and 0·60 metre (1 ft. 11¾ in.).*

The list furnishes some interesting figures of cost. The actual cost of the Stolp-Rathsdemnitz line, 11 miles long, 4 ft. 8½ in. gauge, opened in 1894, is not given, but, so far as the *data* go, appears to be £2582 per mile. The line from Bromberg Station to the cattle market, 2 miles long, 4 ft. 8½ in. gauge, opened in 1893, cost £1590 per mile. The Stralsund-Barth line, 41 miles long, metre gauge, opened in 1894, cost £2393 per mile. The Bromberg light railways, 56 miles long, 1 ft. 11¾ in. gauge, were estimated to cost £1626 per mile. The estimated cost of the Wilkovo light railways, 34½ miles long, 1 ft. 11¾ in. gauge, was only £848 per mile.

The capital for the lines given in Lord Granville's list was provided by the contractor, the province, the district, and the parties concerned, either separately by one, or jointly by two, three, or all four. In most instances the contractor supplied the money. Referring to the lines already mentioned, it may be noted that the capital for the line from Stolp to Rathsdemnitz was provided, in practically equal amounts, by the province, the district, and parties concerned; that for the line from Bromberg to the cattle market, the Bromberg light railways, and the Wilkovo light railways, by the contractor.

Before the law of 1892 was put into force, the provision of light lines was mainly confined to town service, and 83 per cent. of them were for exclusively passenger traffic. Since then at least three-fourths of the new light railways have been designed for town to town communication and mixed traffic. It is anticipated that electricity will be largely employed as the motive power, and it is already (up to Sept. 1896) used on 38 light railways.

It is exceedingly difficult to obtain useful information in regard to results of working. According to *Engineering*, 2nd Nov. 1894, the light railways in Germany, with a mileage of about 500, mostly narrow gauge, earned gross receipts of £400 a mile, and paid from 2·2 to 2·5 per cent. on capital outlay. On the Bavarian light railways in 1893 the gross receipts[*] were £106,601, and the expenses £55,588, or 50·26 per cent., on gross receipts of only about £5 per mile per week. These Government light railways are all of standard gauge, 4′ 8½″, to take main-line goods wagons, but are under separate management; about two-thirds of the traffic are goods; and the method of working is extremely economical. About the Rath-Greding Railway, as a particular instance of economical working, information is also given by Mr Money; here, it will only be mentioned that the line was opened in 1888, is of standard gauge, cost £2858 for construction and £269 for rolling-stock per mile, employs 30 men, or 1·23 per mile, earns total receipts of £3842 (about £3 only per mile per week), and is worked at a cost of £2636, or 68·61 per cent. of gross earnings.

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* This gauge is largely used for military purposes. Information regarding curves, gradients, permanent way, and rolling-stock is given in *Min. Proc. Inst. C.E.*, vol. cxvi., 1893-94,—"Experience of the Prussian Railway Dept. in the Construction and Working of Narrow-Gauge Railways."

In regard to economical working on German light lines generally, we have seen that the States could—with the approval of the Imperial Government—relax the regulations considerably.

Accordingly, at speeds of less than twenty-seven miles an hour, a buffer compartment (instead of a buffer vehicle) might be sufficient between passengers and engine; even for omnibus trains on main lines the conductor might have sole charge of the train, sell tickets at stopping places where no staff was kept, and look after luggage; the driver and stoker, who worked the engine, might also grease the carriages; women might be employed as gate-keepers; temporary men might be taken on without the usual qualifications; fencing need not be continuous; gates at level crossings might not be required; trains might halt between stations; the telegraph and road-bell signals might be dispensed with; fixed (not only distant, but even main) signals might not be considered necessary; facing-points might not even have point-indicators; the stoker might be dispensed with on the engine; mixed trains would, of course, be permissible; trains, being ordinarily limited to 120 axles, might be pushed if they did not exceed 50 axles, with a man in the leading wagon, and at a speed not exceeding nine miles an hour; authorised station-masters might not be required at stopping places; and the brakes on vehicles (excluding those on the engine and tender) might be one axle in every 12, 10, 8, 7, 5, or 4 on inclines of 1 in 500, 300, 200, 100, 60, and 40 respectively.

In some cases, ordinary lines were actually disclassed to take advantages of the simplifications thus accorded to light lines.[†]

The opinion of the German Government is that "in general, the light railways appear to be well adapted to the development and improvement of agriculture and forestry and their accessories, particularly to opening up new markets and facilitating the carriage to and fro of manure and raw produce, over a considerable area of country."

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[*] Appendix iii., "Money on Light Railways," vol. cxxiii., *Min. Proc. Inst. C.E.*, 1895–96.

[†] "Exposé de la Question des Lignes à faible Trafic," by J. Lewis,—*Bull. de la Comm. Internat. du Congrès des Chemins de Fer*, 1892.

AUSTRIA.

At first the Austrian Government was inclined to look upon railways with the cold eye of dislike and discouragement. As early as 1838, however, Austria had a general railway law, such as we did not obtain until 1845; and after that, for eight years or so until the revolution of 1848, the State both built railways and assisted others to build them by guarantees of interest. Then, at the very time when Prussia was buying up railways, the Austrian Government were selling theirs, and selling them badly, to private companies. For the backward condition of her railway communications Austria suffered accordingly in her war with France in 1859 and with Prussia in 1866. A few years of reckless enterprise and speculation followed. Roused at last, in 1873, the Government determined, so far as the limited resources of the Treasury would allow, to pursue thenceforward a policy of State ownership and management. From time to time, moreover, railways of a lighter description—officially known as "local lines" (*Localbahnen*) since 1875—were built, under special laws, at the cost partly of the State and partly of private persons. In obedience to popular demand, a law was passed in 1880 to afford further facilities for developing such lines, even without the co-operation of the State, by means of concessions; greater freedom in details of construction and working, rates, service of trains, and speed; permission to lay such lines on public roads, etc. For some years, under the stimulus of this law, local lines were freely built, but the results were not sufficiently remunerative to private capital, and it was only after the law of 1887 was passed that active promotion of these railways was resumed. If the capital could not otherwise be raised, the Government might help with a fixed subsidy, or undertake the working on the condition that the local authorities bore an equal share, while the laying of railways on State or other public roads was still less restricted. Existing lines, submitting to the inferior classification and slower speeds, could also be admitted to like privileges—in fact, the law gave the Government a very free hand. If the speed on these local (secondary or vicinal) lines did not exceed (28 kilometres or) 17½ miles an hour, considerable economies in station, train, and engine staffs were permissible; fencing, telegraph, and gates might be dispensed with; the drawing up of time-tables and settlement of rates within the maximum limits were left to the concessionnaires. In the concessions granted to local lines might be included exemption from taxes which weighed heavily upon the main lines, from free carriage of mails, from police charges, from supervision charges, from stamp duties, from the stamping of passengers' tickets, etc. Junction facilities were afforded to local lines connecting with main lines worked or guaranteed by the State, and the common use of main line stations was given to them, free of charge. If the Provinces, the Communes, and private persons contributed a reasonable share of the cost of such lines, the Treasury might furnish subsidies; or State aid might take the forms of grants of land or materials of construction, or of guarantees of gross or net revenue. A State main line might work a local branch for less than the actual cost of working, the State reserving the right of running State trains over the branch by paying toll.

Between 1880 and 1886, under the law of 1880, upwards of 87 local lines were constructed, covering a length of 1491 miles (2399 kilometres). In 1887, as we might suppose, nothing was done. Between 1888 and 1893—under the law of 1887—45 local lines, covering a length of 743 miles (1195·6 kilometres), were constructed.

The Diet of Styria led the way in 1890 by raising £833,333 (10,000,000 florins) to be drawn upon for the construction of local railways. Either the State or interested parties, or both together, must supply a third of the required capital (in lump sum or by subscription shares), and must guarantee ⅜ths of the interest at 4 per cent. on the capital. These provincial lines would be worked, if possible, by the administrations of the main lines with which they connect, at actual working cost; otherwise they would come under provincial management. The application of the law is entrusted to a mixed Commission, representing official and commercial interests.

The Diet of Bohemia passed a similar law in 1892. The subscription took the form of a guarantee of interest.

The Galician Diet followed suit in 1893, but although, by this law, £25,000 (300,000 florins) was, for a period of thirty years from 1894, to be provided in the annual budget for light railway subsidies, the view taken by the Diet was that light railways should, as a rule, be left to private enterprise, and only assisted after the most cautious and thorough examination of each project.

A great deal of the above information has been gathered from a note by Herr E. A. Ziffer in the *Bull. de la Com. Int. du Cong. des Ch. de Fer*, 1895. The rest of the note is mainly a eulogium of such narrow gauges as 2′ 6″ (0·76 metre or 29·92 inches). Without going too much into details here a few of his facts may be mentioned. When a line was to be constructed from Nenhas to Nenbistritz, a distance of 11¼ miles (18 kilometres), it was estimated that it would cost £125,000 on the normal gauge against £95,000 on the 2′ 6″ gauge, and the latter was accordingly adopted. In 1892 the Imperial and Royal Railway of Bosnia (2′ 6″ gauge), 166 miles long, showed expenses of £286 against receipts of £531 per mile. This railway, with the State railways of Bosnia and Herzegovina, makes up a system 379 miles (609 kilometres) in length, the longest in Europe, of 2′ 6″ lines; the average cost of them up to 1891 was £7065 per mile; the cost of them would have been £12,662 per mile if they had been laid to normal gauge; and they pay interest at about 3 per cent.

In Austria-Hungary,* the encouragement given to light railways has taken the form of relieving them from the heavy dues charged on ordinary railways, and of affording them special commercial and technical facilities, while the Provinces have backed the policy of the Central Government with actual financial assistance.

HUNGARY.

The construction of local railways in Hungary began as long ago as 1860, and a distinction was made between secondary lines on the normal gauge and tertiary lines on the narrow gauge.

The public roads were either insufficient, or in bad repair, and the development of agriculture and forestry, much more marked than that of manufactures, increased the demand made by local authorities and private persons for local railway legislation. Under such continued pressure the laws of 1880 and 1888 were passed.

While an ordinary railway requires a special law, concessions for a local line may be granted in an ordinance by the Hungarian Minister of Commerce for a period of 50 years, and reserving the right of pre-emption.

If the line passes through State property the State will contribute to the cost of construction. The Minister of Commerce may subsidise the line (in return for carrying the mails), but the subsidy, capitalised at 5 per cent., shall not exceed 10 per cent. of the actual cost of constructing the railway. For subsidies up to the 10 per cent. limit the State Budget may annually be debited with £25,000. The Hungarian State Railways will carry construction materials at actual cost of pocket expenses; will supply engines, etc., from their locomotive workshops at long credit; will furnish rolling-stock at moderate rent to those local railways that they work; and are bound to take over (as also are State-guaranteed private lines) the working of local railways which connect with them, on the condition that they receive compensation, if actual expenses are not covered. Moreover, the Minister may demand that the working of a local railway be handed over to a State or State-guaranteed railway.

The Minister of Commerce may refuse concessions to local lines if those who benefit by them do not contribute 25 per cent. of the required capital. The municipal and district authorities may also contribute and levy special taxes for the purpose. The actual construction capital is fixed by the act of concession; the amount, and the method and conditions of subscription, of the normal capital, the kinds of stock to be issued, the dividends, and fixed interest are defined by the Minister of Commerce. The maximum rates are laid down in the act of concession, and reductions may be called for if the net profit is as much as 7 per cent. per annum three years running; but within the maxima the concessionnaires have a free hand.

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* *Bull. de la Comm. Internat. du Congrès des Chemins de Fer*, 1891,—"La Législation des Chemins de Fer Économiques."

In regard to brake power, it will be interesting to quote the table * recommended by the "Union des Chemins de Fer Allemands," and apparently adopted in Austria-Hungary:—

On Gradients of—		Second Class Lines.				Local Lines.
		Brake Power. Per cent. of Gross Train Weight for Speeds, in Miles per Hour, of—				
per 1000.	1 in	15.	18.	21.	24.	Up to 18.
0	∞	6	6	6	6	6
2·5	400	6	6	7	9	9
5	200	6	7	9	12	12
7·5	133⅓	8	10	12	15	15
10	100	10	13	15	18	18
12·5	80	13	15	18	21	21
15	66⅔	15	18	21	24	24
17·5	57⅐	18	21	24	27	27
20	50	20	23	27	31	31
22·5	44⁴⁄₉	22	26	30	34	34
25	40	25	29	33	37	37
30	33⅓	30	34	38	43	43
35	28⁴⁄₇	34	39	44	49	49
40	25	39	45	50	56	56

Telegraph need not be provided if there are no crossing-places and no night-running. Three mixed trains a week at fixed times are the moderate demand in the matter of train service. For thirty years (unless, after ten years' working, they are paying as much as 6 per cent.) local lines may be exempted from stamp duties and other taxes; nor do they have to pay for police. Among other burdens, they are (during the first ten years) relieved of the heavy transport

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* *Bull. de la Comm. Internat. du Congrès des Ch. de Fer*, vol. vii., 1892.

taxes, which amount to as much as 18 per cent. on passengers, 7 per cent. on express goods, and 5 per cent. on slow goods.

At junction or joint stations, the service of the local line is performed by the main line sometimes at cost price, but gratuitously as a rule. All that is demanded of the connecting local line is the provision at its own cost of any necessary new installations. Handling expenses are paid by the line that incurs them.

Fencing and level-crossing gates are only provided if specially required. Although the telegraph is not obligatory, it is sometimes adopted as a matter of convenient working; the telephone is more frequent; the road-bell signal is dispensed with. Point indicators and disc signals are confined to junctions and crossing-stations, as a rule, but electric-bell control of points, or interlocking of points and signals may be exceptionally required in the specification; outside points have to be padlocked. In mixed trains the passengers are, so far as possible, placed in the rear half of the train, at anyrate not immediately behind the locomotive; but a buffer vehicle is only considered necessary under certain conditions of speed and composition of trains. Special facilities are adopted for the sale of tickets.

The average mileage of local lines (*Vicinalbahnen*) open in 1888 was 1144 (1831 kilometres), and in 1893, 2333 (3733 kilometres); the gross receipts were £245 per mile (1839 florins per kilometre) in 1888, and £284 per mile (2131 florins per kilometre) in 1893.

Official statistics show a total mileage of 2326 (3722 kilometres) in 1892, of which little more than 5 per cent. was on a narrow gauge, 2 ft. 6 in. (0·76 metre). In this are included sixty local lines, which, with five others under construction, represent capital of £10,696,430 (128,357,161 florins). Towards this amount the percentage of State subscription is 13·3, of the municipalities 7·5, of the districts, etc., 12·4—total percentage of public contributions 33·2 or £3,557,653. The remainder, £7,138,777, represents the satisfactory share taken by private enterprise.

The standard-gauge lines cost £4124 per mile, the 2 ft. 6 in. gauge lines £3394; but, in making a comparison, it must be remembered that the State railways working any of these lines generally furnished the rolling-stock.

Of these sixty local lines, 442½ miles were worked by the local lines themselves, 142 miles by private main lines to which they acted as branches or connections, and the remaining 1741½ miles by the State railways, either (*a*) at the expense of the enterprise, (*b*) at the expense of the State railway, (*c*) as proprietors, or in most cases (*d*) under working agreements.

The rolling-stock belonging to the local lines consisted of 108 engines (0·046 per mile), 236 carriages (0·101 per mile), and 1714 goods wagons (0·73 per mile).

The gross receipts averaged £302 per mile; the working expenses £165 per mile or 54·7 per cent. of the receipts. But the receipts varied between such wide extremes as £806 per mile on one line, and £17 on another; and the percentage of expenses to receipts may be as little as 36·1 or as large as 89·5.

The average interest on capital was 3·31. This seems very satisfactory, but it "is due partly to the *sufficiently high passenger and goods rates charged*, and partly to the working agreements entered into with the State railways. According to these agreements the State receives a fixed sum per passenger mile and per ton mile of goods. Hence in every case some profit cannot fail to accrue unless the private companies spend sums above and beyond working expenses properly so called.

"In spite of the subsidy provided by the Hungarian State railways by means of working agreements, and amounting to the sum of £25,000 (300,000 florins) at least, still the net proceeds of the local railways are insufficient to meet the interest on preference shares, and the ordinary shares bear, as a rule, no interest." * Of course, one of M. Ziffer's remedies for this is the adoption of narrow gauge, but that is an open question still. His other suggestion, to lease out the working of the lines,—"as State working is too much tied and bound by regulations and lacks elasticity"—is more likely to be accepted even by those who disagree about the former.

Finally, since it is too concise to be abridged, Mr Ralph Milbanke's report on Secondary Railways in Hungary† may be quoted *in extenso.*

"There were sixty secondary railways (*Vicinalbahnen*) in Hungary in the year 1892:—

Mileage in 1892, ...	3722 kilom.
Gauge—	
Ordinary, ...	1·435 metres.
Narrow, ...	0·76 ,,

"The capital necessary for the construction of secondary railways has, as a rule, been obtained by private enterprise, to which, however, the State, the municipalities, the parishes, and others have contributed, either in fixed amounts, in subsidies, or by offering some guarantee according to their interest in the railway to be constructed. Such contributions have been made in exchange for ordinary shares, or, *à fonds perdus.*

"The State also remunerates such railways for carrying the mails, either by yearly payments of certain amount in proportion to the services actually rendered, or by arranging an annual average sum payable for a certain series of years.

"These annual payments are usually capitalised and discounted by a bank.

"There are also instances of municipalities guaranteeing the yearly payment of interest and the quota of amortisation of the debentures issued by such railways.

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* *Bull. de la Comm. Internat. du Congrès des Chemins de Fer*, 1894,—"Local Lines in Hungary," by M. Ziffer.

† *Reports from Her Majesty's Representatives Abroad on Light Railways.*

"The companies formed for the construction of such railways usually issue ordinary shares, which must represent at least 35 per cent. of the actual building capital. The balance is then represented by preference shares or preference bonds (debentures).

"The total of the contributions to the actual building capital of such railways represented, at the end of 1892, 33·2 per cent. of that capital, out of which the State contributed 13·3 per cent., including 5·6 per cent. for carrying the mails (capitalised), 7·5 per cent. being contributed by the municipalities, and 12·4 per cent. by the parishes and from other sources.

"It might be of interest to notice that the contribution of the State to the actual building capital of the secondary railways amounted at the end of 1892 to 17,167,680 florins (about £1,430,640), for which the State has received ordinary shares of the nominal amount of 11,772,190 florins (about £1,231,015), whereas the balance of 2,395,490 florins (about £199,625) was given *à fonds perdus.*

"The contributions of the municipalities amounted at the end of 1892 to 9,588,442 florins (about £799,036), of which about 25 per cent. were given *à fonds perdus*, and the balance in exchange for ordinary shares.

"The secondary railways are managed either independently by the companies themselves, or by the State railways on the basis of contracts.

"Such railways cannot be looked upon as paying undertakings for the present, especially for the holders of ordinary shares.

"It must, however, be considered that the ordinary shares are for the greatest part held by the contributors who have greatest economical interest in the construction of the lines, owing to the facilities of communication thereby obtained, and to the consequent increase in the value of their estates.

"As to the State contributions, they are counterbalanced by the increase of the traffic of their own lines, as well as by the general economical development to be expected in the districts through which the secondary lines pass.

"In fact, out of the sixty secondary railways, only eight have paid dividends on their ordinary shares up to the year 1892.

"The income of the secondary railways was :—

	1891.	1892.
	Per cent.	Per cent.
In proportion to the actual capital .	3·12	3·45
In proportion to the nominal capital (excluding the ordinary shares) .	4·30	4·61

"The percentage of the deficit, without reckoning the ordinary shares, and only taking into consideration the sums required to meet the interest, and the quota of amortisation in 1892, was 11·09 per cent.

"The receipts in 1892 were:—

	Kreuzer.
Per passenger, ...	1·70 per kilom. (About $\frac{3}{10}$d.)
Goods, per ton, ...	3·62 per kilom. (About $\frac{7}{10}$d.)

"Whether, and to what degree, the secondary railways have stimulated the production and sale of dairy products, eggs, fruit, and vegetables, and products of other small industries in the districts through which they pass, cannot be ascertained."

HOLLAND.

In Holland, local railways* do not necessarily mean—as in France or Belgium—those which are to a great extent paid for out of the local treasuries, and whose very existence depends upon the Provincial and Communal Councils. The essential difference between local and normal railways is one of special facilities, and the relief of the former from the regulations for construction and working imposed on the latter by the law of 1875. This relief, afforded by the law of 1878, was partial in the case of those local railways upon which the axle-load was limited to 9·84 tons (10,000 kilogrammes), and the speed of trains to 18½ miles (30 kilometres) an hour; it was complete, when the speed did not exceed 9¼ miles (15 kilometres) an hour. These maximum speeds were raised, in 1889, to 25 and 12 miles (40 and 20 kilometres) an hour respectively.

The facilities include their release from requirements usually called for in connection with adjoining properties, fencing, details of working, mail service, other communications, etc. The application of the term "local" to such lines is so independent of any relations with local authorities, so purely one of freedom from stringent obligations, that the great companies have been able to place several of their lines under the easier operation of the law of 1878, and to have them classed as local railways.

We may divide them into light railways and tramways. The former do, the latter do not (even when of the same gauge), make direct junction with the main lines.

The construction of light railways, which are not numerous, was conceded by royal decree to private companies, but their working has been leased by the latter to main-line companies, *e.g.*, the Dutch

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* "La législation des Chemins de Fer Économiques," par M. Colson,—*Bull. de la Comm. Internat. du Cong. des Chemins de Fer*, 1891.

Railway Company, upon terms which differ considerably in one case and another. These lines have been constructed almost universally without financial assistance from the State, and always without a guarantee of interest. The districts traversed have advanced, in some instances, as little as one-tenth of the capital; but the shares of the companies have often been subscribed by the Communes and the particular persons interested.

These light railways are all laid to standard gauge, but with a rail weighing not more than 51·6 to 60·5 lbs. per yard (25·6 to 30 kilogrammes per metre). The open line is, of course, single. The formation is narrower, the gradients and curves are sharper, and the station and signalling arrangements are simpler than on the normal railways. Fencing is only required in exceptional places, such as station yards. In 1894 there were* about 160 miles (258 kilometres) of light railways in Holland.

They make junction with the main lines of railway, and can carry their 10-ton wagons without splitting the load. The great railway companies working the light lines employ upon them special tender-locomotives, and special carriages for two classes of passengers.

The light railways constructed by the Gelderland-Overijssel Local Railway Company form the most important network. They make up a total mileage of about 82 (131·88 kilometres), and cost, not including rolling-stock, about £3461 per mile. The official report transmitted by our representative at The Hague, Mr Bland, gives the following information:—

"The construction of this net, which is 131·88 kilometres long, cost 3,013,080 florins (£251,000), or, including the advances made by the company working it up to the 31st December 1893, 3,405,758 florins (£283,813), which is about 25,800 florins (£2150) per kilometre.

"The cost of the rolling-stock is not included in the above amount.

"The company's capital (shares) amounts to 1,900,000 florins (£158,333), and was most of it supplied by the Communes and by private individuals in the district. The advance, free of interest, of the Province of Overijssel amounted to 2715 florins (£226, 5s.) per kilometre, or to 67,194 florins (£5599) altogether; that of the Province of Gelderland 10 per cent. of the cost of construction of the line Ruurlo-Doetinchem, not exceeding 215,800 florins (£17,983).

. . . .

"A considerable quantity of merchandise, as well as a large number of passengers, are carried by the local railways.

"A great quantity of coal is carried on the Gelderland-Overijssel line, as well as raw and manufactured materials, between Rotterdam and the manufactories in Eastern Overijssel. These lines have also a very perceptible influence on the industries in East Gelderland."

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* *Reports from Her Majesty's Representatives Abroad on Light Railways*, 1894.

The traffic on this network of light railways is a growing one, and in 1893 the receipts were:—

For passengers, . . .	88,145 florins	= £7345.
For merchandise, . .	190,237 florins	= £15,853.

Not only did the Provinces make advances, to the amount of about 10 per cent. of the cost of construction, and the Communes interested also assist, either with subsidies or by taking shares, but the great railway companies treated the light lines most generously, and the relations which exist between them appear to be most satisfactory. The main line has undertaken extensions and enlargements at its own cost, under certain conditions. If it works the light railway, the main line generally lets it use its stations and approaches free of charge; if the light railway is self-working, a small charge per train-mile, subject to a minimum, is made for the use of them; joint-station working expenses are divided in proportion to traffic.

The terms on which the Dutch Railway Company works eight contributive light railways, take the form either of a lease or of a partnership.

In the first case, according to M. de Bäcker's report* on "Contributive Traffic," the main line pays the light railway either a rent representing so much interest on the capital expenses, or the sum necessary to provide interest and sinking fund on the loan, or a percentage of the receipts after deducting the working expenses, which are on a fixed mileage basis. In the second case, the two companies share the net profits in proportion to their share of the capital. In both cases the working company is responsible for any deficit.

As far as possible, says M. de Bäcker, and always on the lines worked by the Dutch railway, there are through passenger tickets. Through consignment of goods, generally without transhipment, is also provided for. The contract for hire of wagons stipulates that they be loaded within six hours, but their occupation between 8 p.m. and 6 a.m. is not paid for. The main lines employ special tender-locomotives, and carriages for two classes on the light railways.

The Dutch light railways show how much can be done, less by direct pecuniary assistance, than by generous treatment and facilities tendered to such undertakings by the State and the great railway companies.

The true light railways of Holland, however, in M. Colson's opinion, are those laid on roads—"tramways"—which, beyond a restriction of speed to twelve miles (20 kilometres) an hour, enjoy otherwise the most absolute freedom. Under the law of 1880, these tramways are brought under the same regulations as ordinary road traffic, as determined by the provincial authorities, with the single exception that the locomotives are subject to the usual rules affecting steam engines. They require, therefore, no special concessions; but while they share the freedom of ordinary road traffic, they have to submit to the same tolls, which are very numerous on the Dutch roads. These tolls are levied on each vehicle, and, as a natural consequence, these vehicles are of large size.

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* *Bull. de la Comm. Internat. du Cong. des Chem. de Fer*, 1895.

The State (represented by the Minister), the Province, the Commune, the Land Reclamation Society, individuals—whoever may be the proprietors of each road—have absolute power of permission or veto to use the road for tramway purposes. The regulation of these tramways varies with different local authorities, but the latter treat them as liberally as possible, knowing that they are beneficial to the country. Instances of obstructions on the part of road-owners are extremely rare.

Some of the tramways are the property of the great railways, a few belong to the tramway companies of the large towns, but most of them were constructed by separate companies; of the last, a few are worked by the great railways or tramway companies, but most of the companies work their own lines.

Those which belong to the great railways are all worked by steam, are of standard gauge, and make direct junction with the main lines.

Of steam tramways exclusively, there were in 1893 about 486½ miles (783 kilometres), viz. :—

26	miles of	2′ 5½″	(0·75	metre)	gauge.
49	"	3′ 3⅜″	(1·00	")	"
258½	"	3′ 6″	(1·067	")	"
153	"	4′ 8½″	(1·435	")	"

"The tramways of the private companies do not"—according to Mr Bland's report—"admit of direct junction with the main lines, even when their rails are the normal width apart. The construction of the tramways does not permit the passing over of the luggage wagons of the railway companies, nor can the rolling-stock of the tramway companies be taken on in the trains of the railway companies.

"The merchandise and luggage must be unloaded and reloaded at the junction.

"Tender locomotives of 8½ to 13 tons are employed on the steam tramways. On a few lines locomotives are employed up to 16 tons.

"The construction of the tramways under the second division* was assisted by the Provinces and Communes, in many cases in the form of payments annually for a certain number of years. Up to this time the State has given a subvention in one case only. . . . .

"The traffic on the tramways of this class, from the nature of the subject, varies very much. On most of them the passenger traffic is the principal thing, and the conveyance of merchandise of small account.

"This last is mostly confined to parcels, and is chiefly of local character.

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* *I.e.*, tramways proper, not town tramways.

"Milk, green vegetables, etc., are conveyed to adjacent dairy produce manufactories and towns, but, except in a few cases, this conveyance is inconsiderable, being restricted to small quantities in consequence of the numerous navigable canals.

"Cattle are seldom conveyed, as they are generally driven to the railway stations and there put into the trucks. On many tramways, also, there is but little conveyance of wood, building materials, coal, and such like bulky goods. On some lines in direct junction with the railways, and on others situated in industrial districts, or where the cultivation of beet-root is carried on, a very considerable amount of merchandise, however, is conveyed."

Sometimes a Commune will give a small annual subsidy for ten years to a tramway, in other cases a Commune will contribute a small lump sum towards construction; similar subsidies from the State or a Province are extremely rare; and in all cases private subscribers contribute the great bulk, or all, of the capital.

As in Italy, so in Holland, light railways laid on public roads have been the most prominent development, and their comparative success is attributed by M. Colson* to their being untrammelled by legislation, and fairly free to settle their own rates and arrange their own train service, so that the charges are as low and the revenue is as large as the application of ordinary business principles can make them.

SWITZERLAND.

More than twenty years ago there was a movement to introduce narrow-gauge lines in Switzerland, but it died out. There have been some signs of revival during the last few years, mostly in the direction of railways to meet the requirements of tourists. Their development seems to depend upon the encouragement given by the Cantonal Authorities to private companies applying for a concession.

Thus, in the Canton of Geneva, concessions were granted by the Government to certain citizens for nine narrow-gauge lines, radiating from Geneva. An account of these was given by M. A. Mallet in the Transactions of the *Société des Ingénieurs Civils* of France.†

The area of the Canton is 93 square miles; its population is 107,000, of which the city of Geneva itself claims 70,000. Of ordinary railways there are 19·4 miles, of tramways 9·7 miles, and of these narrow-gauge lines 43·3 miles. The *Société Genevoise de Chemins de Fer à Voie Étroite* works all but one of the light lines.

So far as the gradients and curves permit, the light railways are laid on the side of the roads, twenty-five to forty feet wide, which are maintained by the Canton. The track is not marked off from the rest of the road in any way; the streets of the city are narrow and crowded; the only warnings appear to be the sound of the driver's horn, and the notice "Look out for the train" painted in large letters on signboards at crossing and other special places; while the average speed is from six to nine miles an hour. Yet accidents are few or none.

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* *Bull. de la Comm. Internat. du Cong. des Chem. de Fer*, 1891,—"La Législation des Chemins de Fer Économiques."

† *The Railway World*, March 1895.

The gauge is one metre; the rails weighing 40 lbs. per yard are mostly of Vignoles section, and laid on cross sleepers of wood, except in the city and villages where metal-sleepers on the Demerbe system are adopted.

There are as many as 22 six-wheels-coupled locomotives, workable from either end, roofed over and boxed in below to hide and protect the working parts. Coke fuel is used in the city and briquettes outside. Exhaust steam is not condensed but escapes noiselessly, and there is no trouble on this ground. The engines weigh 13½ tons when empty, and 16¼ tons in full working order; the axle-load is 5·4 tons. The maximum speed is 16 miles. Fuel is expensive, about 25s. per ton.

The passenger carriages have end platforms, transverse seats, and a gangway right through from end to end, leaving seats for two on one side, and one on the other; they contain accommodation for 24 passengers inside, and—this is quite a continental feature—for 12 on the platforms. The cars are heated by pipes through which the exhaust steam passes.

The train crew (as many as three or four vehicles drawn by a locomotive may be seen in the streets of the city) consists of a driver and a stoker on the engine, and one or two conductors to sell and collect tickets on the train. The stoker has to walk in front of the train, in going round sharp curves. Return tickets only are sold at the termini, at shops, cafés, etc. The fares are as much as 1¼d. to 1½d. per mile, except in certain cases where reductions are made. The number of employés is not more than 3 per mile.

These light railways cost (including £768 for rolling-stock) £5760 per mile, but extensions have been made at a cost of only about £2000 per mile. The receipts average £435 per mile per annum; the working expenses £340, about 77½ per cent. of the receipts; and the net revenue £95, giving a return of nearly 2 per cent. on capital.

Only one instance can be quoted of assistance to light railways from the main lines. The Jura-Simplon Railway Company* took shares in the company formed to build the Trasellar-Terannes line, and gave it junction facilities at Terannes.

SWEDEN.

Every year a certain amount of money is allotted by the Swedish Diet† for the purpose of making advances—not to exceed half of the

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* "Contributive Traffic," by M. de Bäcker, *Congress Bulletin of the International Railway Congress*, 1895.

† "Contributive Traffic," *Congress Bulletin of the International Railway Congress*, 1895.

Property of

original construction capital—to companies formed to construct light railways. The Government also grants free use of land and ballast quarries on State domains.

The Swedish State Railways (who furnish this information) also permit the light railways to use their station junctions, either gratis or at a small rental. The light lines build their own sidings, etc., and pay rent to the State Railways for any shunting and handling done for them by the latter. State Railways' goods rates apply to the light lines, and there is a connecting service for goods between the main and feeder railways. The Swedish State Railways* have no light railways of their own. The latter all belong to private companies, are generally on the narrow gauge, are simply constructed and worked, and occupy their own land. Many private railways have been constructed with 35 lb. rails, and for a maximum speed of twelve miles an hour, at a cost of only £2000 a mile.†

So long ago as 1868, Mr C. P. Sandberg furnished figures from the returns very much in favour of the narrow gauge, which he advocated. The State railways were on the standard gauge, with a rail weighing 66 lbs. per yard; the Koping-Uttersbergs Railway on the 3′ 6″ gauge, with a 34 lb. rails. The comparative figures ‡ are here quoted:—

	Koping Uttersbergs.	Government Railways.
	£	£
Cost per mile,	1920	7300
Gross income per mile	216	513
Expenses per mile,	128	352
	per cent.	per cent.
Expenses per cent. of gross income,	59·8	68·6
Net proceeds per cent. of gross income,	40·2	31·4
,, ,, cost of construction,	4·5	2·217

Of narrow-gauge railways § there were, in 1891, about 1050 miles, varying in gauge from 1′ 11⅝″ to 4′ 0″ (0·6 to 1·217 metre).

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* "Relaxation of Normal requirements for Light Railways," *Congress Bulletin of the International Railway Congress*, 1895.

† *Engineering*, vol. lviii., Nov. 2, 1894, pp. 583–84.

‡ "Light Railways in Sweden," *Engineering*, vol. x., 1870.

§ "Narrow-gauge Railways," *Engineering*, July 13, 1894.

RUSSIA.

Russia is such an enormous country that the development of her main line railways must for many years demand nearly the whole of her attention. The great communications in Central Asia, Siberia, and towards the Corea, have been made mainly for military and political purposes. While the State has supplied a great deal of the capital required to build the railways, and has full control over them, it has very little actual ownership* to show for it.

Occupied as Russia has been, however, with her principal lines of railway, a law† was passed in 1887 to establish feeder and light railways on a proper basis. The law deals with *Chemins de fer de second ordre donnant accès aux voies magistrales*, the latter being the main lines.

All these minor lines, public or private, if worked by mechanical motors or connected with the main lines, come under the control of the Minister of Ways of Communication. Public lines on which animal traction is adopted are under the control of the Minister of the Interior. All other lines of railway may be made without special authority, requiring only the agreement of the military authorities in frontier districts, and the consent of the road authorities where the lines cross the public highways.

The form and amount of financial assistance afforded by the State is determined in each act of concession. The maximum speed is fixed at 16 miles (26·675 kilometres) per hour, and the number of trains is prescribed. Statistics of receipts, expenses, and working have to be furnished. Companies projecting light lines are encouraged by guarantees of interest and special facilities. The two Ministers immediately concerned with such lines invite their subordinates to give information, make inquiries, and furnish reports on the development of light railways. Not much has been done so far, but it is not for want of friendly encouragement on the part of the State.

The main lines‡ are favourably disposed towards branch lines. When they advance money for their construction the capital cost is charged to revenue by a suspense account spread over ten years. The main line works the branches. The tariffs on the branches are fixed in each case according to their length, the value of the produce carried, and in inverse proportion to the carriage effected on the main line, which is an indirect bonus.

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* Hadley's *Railroad Transportation*, ch. xiii.

† Colson's "Législation des Chemins de Fer Économiques," *Bull. de la Comm. Internat. du Cong. des Chem. de Fer*, 1891.

‡ "Contributive Traffic," *Congress Bulletin of the International Railway Congress*, 1895.

CHAPTER VII.

LIGHT RAILWAYS IN AMERICA AND THE COLONIES.

CONTENTS.—Railways and waterways in the United States—Railway statistics—Cost of English railways greatly enhanced by expensive procedure and land—American land a premium, not a penalty—Cheap construction the first consideration—Economies in survey and construction of pioneer lines—Economies in road-crossings, signalling, etc.—Improvements, or even reconstruction, when justified by traffic—Maintenance charges heavier—American and English railways further contrasted—Wrightsville and Dublin line—Canadian cheap lines—Brazil—New Zealand—South Australia—New South Wales—Queensland—Victoria—Australian gauges—Encouragement by grants of Crown lands—South Africa.

UNITED STATES.—In the United States the first roads were made and maintained by local authorities. Later on, turnpike roads for through communication were built by companies, not, as in England, by trusts. During a brief period the construction of certain important trunk roads was held to be a matter of national concern, to be paid for out of the national purse; but the value of these as routes of emigration and traffic to the north-west and south-west was greatly diminished by the development of the Erie Canal and its connections. Cities sprang into existence upon its banks, and business and prosperity increased the more rapidly as the rates for transportation were reduced. But already the railways—of which the Baltimore and Ohio is generally regarded as the pioneer—were pushing their way westward, and the contest between them and the great waterways—the Erie system and the Lakes in the north, the Mississippi river in the south—had commenced. To this contest, in a great measure, the United States owe the low freight charges upon which the bulk of their railway traffic thrives.

English and American railways have one remarkable point in common—their reliance upon private enterprise. The most striking difference between them is, perhaps, in their cost—£48,375 per mile being the average cost of English, and £12,419 per mile that of American railways.

The following statatics* for the year ending June 30, 1896, will indicate the general results on American railways at the present time:—

Railway capital,	$10,566,865,771	Gross earnings,	$1,150,169,376
Outlay per mile of line,	59,610	Total mileage,	182,776
Capital stock,	5,226,527,269	Number of locomotives,	35,950
Preferred capital stock,	969,986,692	Cars of all classes,	1,297,649
Total dividends,†	87,603,371	Cars in freight service,	1,221,687
Passengers carried,	511,772,737	Operated mileage (on 151 roads) in the hands of receivers,	30,475
Freight tonnage,	765,891,385		

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* *Herapath's Railway Journal*, Oct. 29, 1897.

† A fraction over 70 per cent. of the capital stock paid dividends.

This difference in cost is mainly due to the difference in conditions. In England a special Act of Parliament has to be obtained. The case is dealt with by a Committee, first of one House and then of the other. Local bodies, private individuals, railway, gas, water, canal, tramway, harbour, and dock companies, who consider that their interests are threatened by the new scheme, oppose the application, and, in addition to the "House fees," thousands of pounds are spent by both sides in their endeavour to get the Bill either thrown out or passed. No doubt this is good business for the lawyers and engineers engaged, but it adds enormously to the cost of even the great railways, and has been absolutely fatal to the promotion of light lines.

The English railways have had to pay heavily for land and other property, and to buy out affected interests at great expense, while the Western and Southern railways in the United States were freely assisted with gifts of land which formed a rich endowment constantly growing in value.

Then most of the American railways were literally pioneers in a new country, clearing the way for the spread of immigration, the cultivation of virgin soil, the building of new towns, and the creation of new industries. All these things would, it was hoped, follow, but they did not exist along the line of route. In England the railways were extended along established routes of traffic, and carried on from one business centre to another. Capital was abundant, and the demand for substantial construction was at once complied with. In the United States, as Professor Hadley* said, "the question was not what kind of a railroad they were to have, but whether they were to have any at all." Reduction of first cost to the lowest actual requirements—the principle to be applied to light railways—was, therefore, a prime necessity in the construction of the American trunk lines. The main object was to get the railway through; the substitution of permanent for temporary structures, and the gradual improvement of the line up to the standard required by the traffic as it developed, were deferred until the line earned enough to pay for them. This was the only way in which the railways could be built. And, since economy in construction was the first consideration, the methods and cost of working had to be subordinated to it.

The steeper the gradients that we can surmount, and the sharper the curves that we can work round, the greater the saving in length of line, in earth-work, and in bridge-work. The American built locomotives to face the inclines, and bogie-stock to yield to the curves. This left him a freer hand in locating his alignment and in grading his section, so that his opportunity for saving in first cost began with the survey.

His permanent-way was limited to a single track, instead of double line as on the majority of English roads. This not only reduced the quantity of permanent-way by about half, but made a vast difference in earth-work, ballast, bridging, etc. Moreover, he adopted the flat-footed or Vignoles rail, resting directly on the sleeper, instead of our bull-headed and heavier rail, keyed up in a good solid chair and well bedded in ballast. He could afford to be liberal with his wooden sleepers, but his iron, steel, and labour were much more expensive than ours.

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* *Railroad Transportation*, p. 148.

When the Sibi railway was being rapidly laid for military reasons on the Baluchistan frontier of India, the road-bed was prepared roughly by ploughing a width of 100 yards to loosen the earth for the packing gangs.

In America the sleepers were simply laid directly on the ground without ballast. To carry the railways across deep depressions, bold dips or cheap trestle-work took the place of our flatly-graded embankments or viaducts of brickwork or masonry. The cost of trestles does not rapidly increase with their height, so that the economy of erecting them in a country where timber is cheap is an important one, but they are a likely source of accident, if such perishable structures are not carefully watched and maintained, and they are always exposed to the danger of fire. In England a substitute of this kind would never be permitted. In India timber for the purpose is not generally available, nor is it required, because earth-work is cheap.

The use of wood as a cheap material is also applied to the construction of station buildings and offices and platform walls. In India, wherever the climate is very dry, we generally find a cheaper substitute than wood in sun-dried bricks set in mud, and covered with mud-plaster, for station buildings, offices, and staff-quarters, or we use grass screens for walls, and thatch for roofs; while fuel platforms, and sometimes passenger and goods platforms, are faced with rail uprights and old sleepers and backed with earth. In fact, Englishmen who make railways at higher cost in England, can make them still more cheaply in India than Americans do in America.

But there are many onerous conditions imposed upon English railways—affecting not only their working but their construction—to which American railways were not subjected, and from which light railways must be relieved. Some of these are demanded in the interests of public safety wherever the traffic is frequent, fast, and heavy, but their imposition on lines of slow and light traffic in country districts, as well as in the busy main lines, has been a serious disadvantage and expense to the great systems, as well as an absolute bar to the development of light railways. Without such restrictions, the Americans have been able to cross town and country roads on the same level, instead of having to bridge the road or bridge the railway. Indeed, the provision of signals and interlocking, or even of gatemen, at such level crossings, has been regarded as a luxury, and it would not be too much to say that they would have been an unjustifiable extravagance in the first instance. The interlocking of points and signals, and the installation of block telegraph, are requirements not to be applied to pioneer lines in America, or to lines of poor traffic in India, but to be provided afterwards if the circumstances of the traffic demand them.

However light a railway we desired to build in India, the bridges would be constructed of brickwork, masonry, iron and steel, save as a temporary measure, but in the United States wooden bridges were an economical necessity.

Of course, all this frequently involved the absolute reconstruction of the original line at a later period. Money for the heavy expenditure on these so-called improvements was provided by the issue of bonds (with the gross misapplication of borrowed capital which ensued in many cases we are not here concerned). It is also evident that economies of the kind above described in construction throw a heavier burden upon maintenance. Thus, the Knoxville branch of the Louisville and Nashville system has been described by an American* as a fair sample of those western and southern railways which represent the true type of American practice :—"They were cheaply constructed, and have been, or are gradually being, perfected, mostly from the earnings, while being operated. They are in the transition stage. Many bridges, buildings, etc., of wood, have been, or are being, replaced with iron or other durable material; iron rails with steel rails, etc. Until these changes are completed, the maintenance of way and operating expenses must necessarily appear large." How large they are, compared with those of a first-class American line, may be seen from the following figures for 1885 :—

Details.	Pennsylvania Railroad Division.	Knoxville Branch.
Length of line, miles, ...	1518	171
Cost per mile, dollars, ...	—	26,624
Average load of freight trains, tons, . .	210	126
,, ,, ,, passenger trains, passengers, .	45	31
,, ,, ,, all trains, tons and passengers,	167	91
Average cost of transporting one ton or one passenger one mile :—	Cent.	Cent.
Maintenance of way, ...	0·080	0·243
Repairs and renewals of locomotives, . .	0·037	0·045
Total cost of motive power, . . .	0·133	0·210
Total operating expenses, ...	0·410	0·819

The comparison is more convincing and instructive between two American lines than, as Mr Dorsey for the purposes of his own argument drew it, between an American cheap line and a first-class English railway, the London and North-Western; because, owing to the difference in traffic conditions in the two countries, figures based on ton-mileage give a false view of English working.

Other points of contrast present themselves—the universal adoption of the bogie principle in American rolling-stock; the greater width (8 ft. to our 7 ft. 6 in.) and height of their cars; through passage from end to end of their trains by means of the central aisle as opposed to our compartment system; the division of service with sleeping-car and express companies, the latter doing for fast goods the work of collection and delivery which is done for higher class goods in England by the railway companies themselves; low speeds, long leads, full loads, and cheaper freight charges for low-class goods in America, instead of the quick transit, short leads, and prompt delivery which obtain in England; the proportion of load to tare in the goods stock, as high as 2·13 to 1 in America, as low as 1·6 to 1 in England; the perfection of our block system; their luggage-check system as compared with our successful lack of any system whatever in this respect, etc.* It is difficult to compare the rates, because so many of ours include collection and delivery, and their terminal expenses have a larger divisor to spread out their cost, but Prof. Hadley estimates roughly that, making allowance for all disadvantages to which our railways are subject, our charges per ton-mile on all traffic average from 50 to 75 per cent. higher. He regards 2 cents per mile as our normal passenger rate, as compared with 2·35 cents in America. Another American, dealing with figures relating to the same year, 1885, puts the average rate per passenger per mile in America at 2·198 cents, and in England about the same, while per ton he makes a greater difference than Prof. Hadley, viz., 1·057 cents in America, 2 to 2·4 cents in England.

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* *English and American Railroads Compared*, by E. B. Dorsey, C.E.

But the main point is that construction in the two countries has been carried out on such totally different principles. In the United States most of the western and southern lines have been practically, in the first instance, light railways. In England first-class railways have been at once constructed, and no departure from the standard has been tolerated. Only now is it recognised that what America required as an undeveloped country, and India as a poor country, England requires in order to carry railways of some sort to districts cut off from home markets flooded with foreign produce.

Mr Arthur Pew† gives an example of an American railway which offers, he says, a practical solution of the problem—"Given a very small amount of money, required any kind of a railroad that will serve the immediate wants of the section, and encourage settlers to move in and develop it." The line connects the two villages of Wrightsville and Dublin, Georgia, about nineteen miles apart, and was constructed in 1885–86. The conditions over the first eleven and a half miles were so extremely favourable that the work of grubbing and clearing, grading, trestles, cross-ties, and ditching, to make the road-bed ready for the rails, cost only $1005, or, including engineering and right of way, $1164½ per mile. Had the location been very unfavourable, this portion of the construction might, as Mr Pew says, have cost forty or fifty times as much. Second-hand rails of light section, 40 to 45 lbs. per yard, were available from the Central Railroad of

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* The "luggage in advance" system is new.

† *Trans. Amer. Soc. of Civil Engineers*, vol. xxiii., 1890.

Georgia, which had been relaid with a heavier rail, and thus the track was put down for no more than $1800 per mile. Ultimately the way and works on the whole nineteen miles cost only $3441 per mile, ready for the rolling-stock. The business was of such a nature that most of the freight was received and shipped in foreign cars, so that $1000 per mile would have been sufficient to equip the line with all the rolling stock that was required, making the total cost $4441 per mile. This additional capital expenditure, however, was happily avoided, as, by the terms of the agreement with the Wrightsville and Tennille Railroad—of which the new railway is an extension—the stock of the latter runs on both roads, and expenses are divided. There were no middlemen to draw their profits out of the scheme, and swell the cost. Mr A. M. Wellington, in the course of discussion, claimed this cheap light railway, built to broad gauge, as a further proof of the small effect of gauge on cost.

In 1887 the Dakota and Montana extension of the Manitoba railway, laid with rails of light section, cost £3000 a mile only.

The United States may be said to have led the way in cheap railway construction. They have also been the first to appreciate practically the advantages of electric traction, and this will be referred to later on.

CANADA.—The Toronto, Grey, and Bruce Railway, and the Toronto and Nipissing Railway, were projected *—the former in a north-westerly and the latter in a north-easterly direction—on either side of the 5 ft. 6 in. gauge Northern Railway of Canada, in order to open up back districts which could only be afforded railway facilities on the cheapest scale. Accordingly, a gauge of 3 ft. 6 in. was adopted. The lines were fenced and fully ballasted, 12 inches of ballast being laid under the sleepers and the road well boxed up. But the rails weighed only 40 lbs. per yard; the station buildings, bridges, and culverts, cattle guards, etc., were of timber; and these lines cost $21,796 (£4541) and $18,390 (£3831) per mile respectively, as compared with $47,840 (£9967), the cost per mile of the broad-gauge Northern Railway. Further details of the locomotives, rolling-stock, and working of these Canadian narrow-gauge railways are given, but the information is not recent enough to quote.

NEW ZEALAND.—Cheap construction was as essential in New Zealand as in Canada. The same gauge, 3 ft. 6 in., and the same section of rail, 40 lbs. per yard, were adopted for narrow-gauge lines. Information concerning them is more recent.† The cost, more than £8000 per mile,‡ is high, but the engineering difficulties must have been exceptional, the ruling gradients being 1 in 40 on the Auckland, 1 in 33 on the Napier, and 1 in 15 *against the heavier traffic* on the

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* *Min. Proc. Inst. C.E.*, vol. xlviii., 1877. Wragge on "Canadian Narrow-gauge Railways." These lines were long since incorporated in the Grand Trunk Railway, and the whole of the Canadian system (16,637 miles) is on the standard gauge.

† *Min. Proc. Inst. C.E.*, vol. lxiii. Maxwell on "New Zealand Government Railways," vol. lxiii., 1881, and vol. xcvi., 1889.

‡ *Min. Proc. Inst. C.E.*, vol. lxxxvii., 1886. Pres. Address of Mr E. Woods.

Wellington section, with sharp curves on the two latter, and wages are as much as 6s. 6d. for labourers and 8s. for gangers per day. Fell engines, weighing 36 tons and designed to haul 53 tons up a gradient of 1 in 15 at 6 miles an hour, are used on the Rimutaka incline, 2½ miles long, with many 5 chain curves. In 1887–8 the amount of goods and passenger traffic passed both ways over the incline was estimated at 50,000 tons of net paying load. As much as 180 tons were hauled at a time, one, two, or three engines being used as required, and so placed as to avoid overstraining the drawbars, and 1½ hour was the time required for the double trip. The cost of coal was 17s. 6d. per ton; 110·73 lbs. of coal were used per mile; and, although the wages of drivers ranged from 10s. to 13s., and those of firemen between 7s. 6d. and 9s. per day, the cost of locomotive power was not more than 4d. per ton of net paying load per mile. The original 40 lb. iron rails are being renewed with 53 lb. steel. The railways are largely an investment in the future. The Hurunui-Bluff section has a considerable agricultural traffic, and its branches tap pastoral districts still to be developed. The leads are short, because the line touches so many seaports, while the maintenance charges due to floods and large bridging are particularly heavy. That the line is doing good service, there is no doubt whatever. The extensions into new localities—mountainous, pastoral, wooded, or mineral—and still lacking labourers in the vineyard, may not add directly to the railway revenues for some years to come, but, in tapping productive, though still unsettled, areas of the colony, they have made development possible. Of the indirect benefit of these lines, constructed as cheaply as possible in a difficult country, there is no question, and, in view of their possibilities, a net revenue of 2·89 per cent. on capital can scarcely be regarded as discouraging.

AUSTRALIAN COLONIES.—The direct results of railways in the Australian colonies are still more favourable, the net revenue being 3·75 per cent. on capital invested in New South Wales, 2·74 on capital cost in Victoria, and 3·26 on capital cost in South Australia.

Some recent statistics of three of the colonies are here quoted:—

	New South Wales.[*]	Victoria.[†]	South Australia.[‡]
Miles open,	2691¼	3129	1723.[§]
Capital cost per mile,	£14,015	£12,250	£7,310
Earnings per average mile open,	£1,138	£837	£595
Gross Revenue,	£3,026,748	£2,615,935	£1,025,035
Working Expenses,	£1,614,605	£1,563,805	£614,254
Net Revenue,	£1,412,143	£1,052,130	£410,781
Train-mileage,	3,674,713	9,228,687	3,674,713
Gross Revenue per train-mile,	7s. 3d.	5s. 8·03d.	66·95d.
Working Expenses per train-mile,	3s. 10½d.	3s. 4·67d.	40·12d.
Net Revenue per train-mile,	3s. 4½d.	2s. 3·36d.	26·83d.

[*] *New South Wales Railways Commissioners' Report*, 1897–98.

[†] *Victorian Railways Commissioners' Report*, 1896–97.

[‡] *South Australian Railways Commissioners' Report*, 1896–97.

[§] Of these, 1229 miles are on the 3 ft. 6 in. gauge, the rest on the 5 ft. 3 in. gauge.

In South Australia* the introduction of the light-railway principle dates back to 1867, when it was determined to extend the 5 ft. 3 in. gauge on a cheaper scale, costing no more than £5500 a mile, including stations and equipment, as well as to adopt the 3 ft. 6 in. gauge on other systems.

The first extensions on the 5 ft. 3 in. gauge, very few additions to the rolling-stock being needed, cost £5247 per mile. The iron rails were as light as 40 lbs. per yard, spiked to wooden sleepers measuring 9 ft. by 9 in. by 4½ in., and spaced 2 ft. 9 in. apart, centre to centre, with a sleeper under the joints, and 8 in. of good limestone ballast underneath. The stations were seven miles apart (about a mile less than the average distance between stations in India), and were provided with goods sheds 60 ft. to 100 ft. long, the walls being built up of galvanised iron on wooden framework fitted into a stone substructure, with a galvanised iron roof on trusses of 45 ft. span. The stationmaster's house was of masonry, the booking-office and waiting-room of iron. The line was enclosed by iron fencing. The low-sided wagons weighed 4 tons 4 cwts., and were designed for a load of 7 tons. A 20-ton locomotive was intended to run at ten miles an hour with goods or passengers, the maximum axle-load to be 7 tons. Public pressure, however, obliged the adoption of heavier engines, and a speed as high as thirty-five miles an hour for passenger trains. The country produces wheat and wool, and the line did a very good business; but the imposition of heavier stock, and demand for higher speeds, required the renewal of the 40 lb. with a 60 lb. steel rail within ten years. For this the axle-load and the speed, not the gauge, were responsible. Other lines were made on the 5 ft. 3 in. gauge on the light-railway principle, costing little more than £5000 a mile.

Lines of 3 ft. 6 in. gauge were built about the same time, with 40 lb. rails also, and at about the same cost, £5042 per mile, including rolling-stock. Private lands are fenced, but most of the land belonged to the Crown. The passenger carriages on the smaller gauge had transverse seats and a central aisle, were 21 ft. 6 in. long and 8 ft. wide, and carried 30 passengers. The goods stock, with a length of 14 ft. and width of 7 ft., consisted of low-sided, medium, and covered wagons, weighing empty 2 tons 17 cwts., 3 tons 3 cwts., and 3 tons 10 cwts. respectively, to carry loads of 6 tons each, and thus giving ratios of tare to load of 1 : 2·1, 1 : 1·9, and 1 : 1·7. The stations were placed as far apart as twenty miles, and included stationmaster's quarters, booking-office, and goods sheds. The water supply was a costly item—600,000 gallon concrete reservoirs every twenty miles, with high service tanks, steam pumps, etc.

According to the Commissioners' Report for 1893–94 the cost of the Southern group of South Australian lines on the 5 ft. 3 in. gauge had reached £9715 per mile, and that of the South-Eastern group on the 3 ft. 6 in. gauge £4110 per mile. These were the lowest figures in each case. Other sections on both gauges cost much more.

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* *Min. Proc. Inst. C.E.*, vol. lvi., 1879. Patterson on "Railway Construction in South Australia."

When minimum first cost is an essential condition of light railway construction, one may be driven, in a country where the standard gauge is so wide as 5 ft. 6 in. or even 5 ft. 3 in., to abandon it in favour of a metre or even a 3 ft. 6 in. gauge. But, in a country which has been fortunate enough to adopt the more common and sufficient gauge of 4 ft. 8½ in. as the standard, the strongest reasons will be required for discarding it in favour of a 3 ft. 6 in. gauge, and the ultimate economy will be secured by constructing a standard gauge line with light way and works, capable of carrying ordinary goods stock at low speeds, but not the main-line engines.

That is the gauge in New South Wales, and the Commissioners, in the supplement to their report for 1893–94, recommended new extensions in purely pastoral and level country on the same gauge: lines capable of carrying a light locomotive, with the ordinary class of rolling-stock, at a speed of about fifteen miles an hour in daylight only, their opinion being that such lines "could be constructed, exclusive of bridges, waterways, and station accommodation (which latter should be of the most simple nature), for £1750 per mile. This could only be a pioneer railway, and would be altogether different from a standard railway line, even of light construction, such as that from Nyngan to Cobar. It would be simply a line to carry traffic with reasonable speed at a lower scale of charges than it is now carried by road. The rates for such lines would bring about a material saving to the users, compared with what is paid for the carriage by road, and the scale of charge should be such as to avoid any material loss to the country. Lines of this character would avoid the great disadvantage of break of gauge; they would cost scarcely anything more in the first instance than a narrow-gauge line, and the whole of the ordinary rolling-stock, inclusive of the engines, which could be selected from the lightest types existing in the service, could pass over them, and thus avoid the great disadvantage and cost of creating a new class of rolling-stock." The advice is sound. Such pioneer railways have been constructed at an average cost of £2019 per mile, and have proved satisfactory both as regards working and traffic. They carry ordinary rolling-stock, hauled by a light class of engine at a speed of 15 to 20 miles an hour.* The adoption of the 4 ft. 8½ in. gauge has again been urged on the colonies of Victoria and South Australia.†

The Normanton-Croydon Railway‡ in North Queensland offers an example of a line cheaply constructed and maintained. Its length is ninety-four miles, and it was completed in 1891–92. The total capital expenditure up to 1893–94 was £271,611, less than £2890 per mile. The ground is so even that scarcely any work of the nature of grading was required. A width of 66 ft. was easily cleared of the dry and stunted vegetation; and in the centre, for a width of 10 ft., stumps and roots were grubbed out to a depth of 6 or 8 inches. In the stiffer loamy soil the road-bed was ploughed up for a width of 8 ft., while in the light sandy loam the surface was merely loosened by scarifying. The formation was then made even by a 3-ton roller. Material was landed at the Normanton wharf, trained up to the extreme end of the laid rails, unloaded and stacked. Four men loaded the material upon the trolleys, and three of these and one horse were engaged in conveying the material from the stacks to rail-head, an average lead of 20 to 25 chains. The fastenings were separately carried ahead in boxes. Each trolley was drawn to the end of the last pair of rails laid until its load was used up, when it was lifted off to make room for the next loaded trolley, and again replaced to be hauled back. Behind the working trolley eight men completed the fastenings. Lifting, ramming, and straightening occupied twenty-five men. The permanent-way consisted of $41\frac{1}{4}$ lb. steel flat-footed rails on wooden or steel sleepers. The latter, where laid on the second section, weighed 100 lbs., and were made by Messrs MacLellan of Glasgow. In section they were trough-shaped, the sides $\frac{3}{16}$ in. thick, the top $\frac{3}{8}$ in. thick, the ends open; and the rails, resting directly on the sleepers, were held by clips and bolts. Their cost was:—

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* *New South Wales Railway Commissioners' Report for* 1896–97.

† Ditto, 1897–98.

‡ *Min. Proc. Inst. C.E.*, vol. cxxiii., 1895, "Steel Sleepers in Queensland," by J. A. Griffiths.

Messrs MacLellan's contract, ...	90d.	120·05d.
Freight, lighterage, and charges, ...	30·05d.	

Mr Griffiths, however, thought that steel sleepers of this pattern might, under favourable conditions, be delivered at a good Australian port at 78d. per 100 lb. sleeper, the steel costing 50d., forming and coating 18d., and freight 10d. With reference to the cost of laying, Mr Griffiths states that a team of twelve to fourteen bullocks, a horse, and fifty to seventy men and boys were employed; the average cost in the earlier stages was over £71, and towards the end less than £59 per mile. The labour charges on the shorter portion of the line laid with wooden sleepers were nearly 50 per cent. more. Of the estimated cost, £2162 per mile was for materials, labour, surveys, plans, and supervision, and about £600 per mile for station accommodation, rolling-stock, surplus material, and land resumption. Ballast had to be used in the slight depressions where drainage collected and the steel sleepers cut in too deeply, but the idea appears to be to let them bed themselves in compressed soil. In flood time the road gives some trouble, but the ordinary maintenance staff consists of only thirty-four labourers, one inspector of permanent-way, and one officer in charge of traffic and maintenance. The work was carried out by daily labour at the cost of the Queensland Railway Commissioners, their paymaster paying monthly wages on the certificate of the superintending engineer.

With reference to the falling-off in traffic receipts it is noted that the rates for all classes of traffic were reduced to about two-thirds of their previous amount, to assimilate them to the southern traffic. This diminished the net revenue by nearly half, and apparently added little to the amount of business done. It seems to enforce the occasional necessity of allowing light railways to charge higher rates to keep themselves alive.

The following figures may be quoted:—

Season (Year),	1892–93.	1893-94.
Traffic mileage,	94	94
Total capital expenditure,	£270,368	£271.611
Traffic receipts,	£20,230	£14,757
Working expenses,	£12,401	£10,301
Earnings per train mile,	118½d.	101¼d.
Percentage of net earnings on capital,	2·896	1·641
Rainfall,	Light.	Very heavy.
Maintenance per mile,	£76·93	£61·73
Labourers per mile,	0·45	0·36

Seven extensions, covering 192 miles, of the State railway system of Victoria* into the Mallee district illustrate the economy of the "butty-gang" system. No large contracts are let, but the work is given out to butty-gangs of any number of men up to sixty at rates which would enable the average man to earn the standard wages in an eight hours day. The district is too sparsely populated to promise much passenger and ordinary goods traffic, but lines were wanted to carry agricultural produce, chiefly wheat, to the seaport at low rates. By only carrying out works indispensable in the first instance, deferring others until the traffic of the district required and could pay for them, and building on the butty-gang system, the price has been kept within £2000 a mile, upon which moderate earnings will yield a profit. By special rollers and ploughs, the scrub and stumps have been cleared and wheat cultivation of extensive areas has been a great success. The surface is generally level or slightly undulating, with occasional sand-hills, an absorbent subsoil, and blind water-courses. The railway extensions have been made on the 5 ft. 3 in. gauge, with 60 lb. steel flat-footed rails capable of carrying all ordinary rolling-stock except the heavier engines. The sleepers are of eucalyptus, tough, heavy, and enduring. Where gravel ballast was too costly, sand has been used on a total length of eighty miles. The excavation for earth-work was from 3400 to 6200 cubic yards per mile. The formation-width is fifteen feet. The bridges are of timber and undecked as a rule, the box culverts are built of sleepers, and the fencing consists of split timber posts and five wires. At public road crossings cattle-pits are used. The stations are six miles apart, with six-inch platforms, the corridor-carriages having steps at the end; but in cuttings the platforms are made up nearly to floor-level, which is convenient in handling goods. The engines are six-wheels coupled, with 12 tons load on the driving axle, and tenders weighing 24 tons, including 2200 gallons of water. They haul as much as 900 tons. Labourers' wages were 5s. to 6s. per day of eight hours. The average cost per mile of these extensions, built between 1893 and 1895, was as follows:—

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* *Min. Proc. Inst. C.E.*, vol. cxxix., 1897,—"Economic Railway Construction in Victoria," by M. E. Karnot.

Clearing and grubbing,	£11
Fencing (93 miles unfenced, 50 miles two wires only),	37
Cattle-pits at crossings,	15
Earth-works (including stations and approaches),	173
Bridges,	33
Culverts,	24
Gravelling roads and approaches,	17
Ballast (sand and gravel),	175
Sleepers,	376
Rails, 60 lb. steel, fastenings, freight, and laying,	659
Temporary station buildings (including platforms),	20
Water supply (temporary),	8
Signals,	3
Telegraph,	13
Engineering and surveying,	167
Miscellaneous items,	4
Interest on capital during construction,	33
Total cost per mile to date of handing over,	£1768
Approximate expenditure since opening,	92
Total cost per mile to 30th June 1895,	£1860

The results prove the economy (as we have long since found in India) of doing without the big contractor.

The variety of gauges in Australia is extraordinary. The 5 ft. 3 in. and 3 ft. 6 in. gauges are found in South Australia, the 5 ft. 3 in. in Victoria, the 3 ft. 6 in. in Queensland and Western Australia. It is unfortunate that the 4 ft. 8½ in. gauge, adopted in New South Wales, is not the standard of all Australia, with the 2 ft. 6 in. gauge to fall back on wherever reduction of gauge is a *sine quâ non*. The question of unification of gauge will come still more prominently to the front if and when the Federation of the Australian Colonies—now being definitely discussed—becomes an accomplished fact.

The cost—if the conversion be complete—will be enormous. The alteration of 1375 miles of 3 ft. 6 in. line in Queensland alone would cost 5½ millions sterling,* while the goods tonnage is only about 4,000,000. A saving, on transhipment of the whole goods traffic, of 1s. a ton, therefore, would only pay about 3½ per cent. on that amount. The conversion of existing rolling-stock would be a formidable undertaking. The laying of a third rail, and cost and complication of mixed gauge, are undesirable. The unification of gauge on the most important inter-colonial routes, and the recognition in future of 4 ft. 8½ in. as the standard gauge, would, however, be more immediately practicable.

* *Min. Proc. Inst. C.E.*, vol. cxxxi. p. 489.

There are no navigable rivers to speak of in Australia, either to take the place of the railways that are lacking or to compete with those that are made. There is a continual demand for new lines to develop the resources of the interior and bring the inland settler into communication with the seaboard. These must be cheaply constructed, and direct and remunerative returns may not always be expected. The results so far are creditable to the policy of encouragement which has been pursued. This is exhibited in the grant of Crown lands and the offer of contracts on favourable terms. The company undertaking the construction of the line may retain the property for a certain period, after which the railway would become the property of the Crown; or the railway, after it is constructed, may at once become the property of the Crown; or the right of purchase by the Crown at a future time may be reserved. The grant of Crown lands is by way of payment or subsidy to the constructing company, and the actual value, without any reference to future betterment, may, in the first case, be equal to twice the cost of construction, in the second or third case, equal to the cost of construction. In addition to these grants of land by way of subsidy for construction, land for the actual occupation of the railway, its stations, offices, etc., would be a free grant from the Crown. Such terms as these have been offered by the Queensland Government.

SOUTH AFRICA.—Ten years ago the cost per mile of the Cape Government railways averaged £8872 on 1599 miles of line open. Last year 1894 miles had been constructed at a cost of £10,165 per mile, and the following figures may be quoted from the *Statistical Register of the Cape of Good Hope for the Year* 1897, "Interchange —Government Railway System":—

	1873.	1887.	1897.
Miles of line open, ...	63½	1599	1894
Number of passengers conveyed, . .	436,512	2,268,207	9,223,676½
Tonnage (Cape ton = 2000 lbs.) of goods, .	66,328	360,043	1,340.414
Train-miles run, ...	135,176	2,865,728	8,873,288
Earnings, ...	£65,695	£1,271,124	£3,070,897
Working expenses, ...	£42,767	£681,837	£1,898,316
Capital invested on lines open, . .	£873,848	£14,186,452	£18,935,559
Net receipts per cent. of capital, . .	£2, 12s. 6d.	£4, 3s. 1d.	£6, 2s. 6d.
Capital expended to 31st December, .	£873,848	£14,186.452	£19.323,155
Cost per mile to 31st December, . .	£13,654	£8,872	£10,165
Working rolling-stock—			
Locomotives, ...	12	227	422
Carriages, ...	37	304	522
Trucks, ...	115	3093	7388
Other kinds of vehicles, . . .	9	319	394
Earnings per train-mile, . . .	9s. 8·64d.	8s. 10·5d.	6s. 11·1d.
Expenses, " " . . .	6s. 3·9d.	4s. 9·1d.	4s. 3·3d.
Expenses per cent. of earnings, . .	65·09	53·6	61·8

The gauge of the Cape Government railways is 3 ft. 6 in., the lines are well and substantially laid, and the trains run at fair speed and are comfortably equipped. The Western system extends from Cape Town to De Aar (501 miles), and branch lines are being constructed to tap agricultural districts. The Northern system starts from De

Aar, passes through Vryburg and Mafeking, and reaches Bulawayo (859 miles). The Cape Government have entered into an agreement with Mr Cecil Rhodes to work the Bechuanaland Railway Company's line from Vryburg to Bulawayo. The Midland system extends from Port Elizabeth to De Aar (339), the trunk line being continued from Naauwpoort Junction into the Orange Free State and the South African Republic. From East London the Eastern system runs to Aliwal North (282 miles), and to Springfontein (315 miles) in the Orange Free State.

There are also 359 miles of private railways—of which one (Port Nolloth and O'okiep—Cape Copper Company) is on the 2 ft. 6 in. gauge, and the remaining five on the 3 ft. 6 in. gauge—but their cost is not given.

Passenger fares are at the rate of 3d., 2d., and 1d. per mile for first, second, and third class respectively, return fares costing only 50 per cent. more than the single fare. The rates for South African produce is ½d. per mile, with terminals; and for imported produce (wheat, mealies, etc.) is 1d. per mile, plus terminals. Import cargo of all descriptions is conveyed at very low rates. Groceries, beer, spirits, carbon for electric lighting, mining machinery, etc., are conveyed from Cape Town to Kimberley for 11s. 1d., and to Bulawayo for 18s. 8d. per 100 lbs.; while cement, printing material, horses, cattle, etc., are charged 5s. per 100 lbs. to Kimberley, and 13s. 1d. to Bulawayo. Over-sea traffic for the gold fields from Cape Town to Johannesburg (South African Republic) is carried at lower rates. From Port Elizabeth and East London, rates on a similar scale are applied to over-sea traffic for Kimberley, Bulawayo, and Johannesburg.

The mileage added to the Cape Government railways during the last ten years is singularly small, considering the increase of railway business during the same period; and the increased cost per mile would seem to indicate that too high a standard of construction has been adopted. If fertile and mining districts are to be opened up, cheap lines should be rapidly constructed on light-railway principles.

We have the Egyptian railways, the Soudan railways, the Uganda railway, and the South African railways still to be linked up, and, as far as possible, on light-railway principles. The Uganda railway is on the metre gauge, but could be easily adapted to that of all the others—the 3 ft. 6 in. The gaps must be filled on the same gauge, for through lines from north to south.

CHAPTER VIII.

LIGHT RAILWAYS IN INDIA.

CONTENTS.—Railways at first constructed by guaranteed companies—State railways—Mileage open—Standard gauge, 5 ft. 6 in.—General statistics—Indian Railways Act of 1890—Fares and rates—Light railways proposed in 1862—Indian Branch Railway Company—Metre-gauge system—Provincial light railways—Punjab feeder lines—Wazirabad-Lyallpur branch—Question of gauge an open one—"Feeder line" terms of 1896—Barsi Light Railway—Ahmedabad-Parantij—Other projects—Examples of light railways—Steam tramways—Development of light railways arrested by uncertainty of exchange.

State Railways.—Proposals for the construction of railways in India * were made as long ago as 1844. In 1849 agreements were signed between the Secretary of State for India and the East Indian and Great Indian Peninsula Railway Companies, under which the companies received a free grant of land for railway purposes, and a guarantee of five per cent. interest, while the Government of India reserved the right of control and superintendence, and the option of purchasing the railways at the end of twenty-five or fifty years.

The development of railways was checked for a time by the troubles of the Mutiny of 1857, but by the end of 1859 about 5000 miles of line were in course of construction, by eight guaranteed companies. In 1869 the State Railways system was initiated. On the 31st March 1897 no less than 20,390 miles of railway were open for traffic, of which 11,736 miles were on the standard or 5 ft. 6 in. gauge, 8366 on the metre gauge, and 288 miles on the 2 ft. 6 in. and 2 ft. or special gauges, as shown on page 118.

The Court of Directors were at first inclined to adopt 4 ft. $8\frac{1}{2}$ in. as the gauge on the East Indian and Great Indian Peninsula Railways. This was the proposal of the companies at home, and, had it been adopted, the gauge difficulty would have been settled for ever so far as India is concerned. The standard gauge in England and India would have been the same, and the reinforcement of Indian railways with locomotives and rolling-stock from England, on an emergency, would be easy; while for lighter lines the 2 ft. 6 in. gauge would be the only, and sufficient, alternative.

Unfortunately, Lord Dalhousie was advised by Mr Simms (who had been sent out from England as consulting engineer in 1845) to advocate a 6 ft. gauge, on the grounds that it would not only secure greater advantages than the 4 ft. $8\frac{1}{2}$ in., but would substantially command those possessed by the 7 ft. gauge. In ultimately deciding to adopt 5 ft. 6 in. as the standard gauge, the Court of Directors committed themselves to an equally unfortunate and singular compromise.

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* *Railway Policy in India*, by Horace Bell, M. Inst.C.E.

The total capital outlay on Indian Railways up to the end of 1896 was Rs.2,73,07,27,181.

TOTAL LENGTH of INDIAN RAILWAYS, open for Traffic on the 31st March 1897.

		Standard or 5′ 6″ gauge.	Metre gauge.	2′ 6″ and 2′ 0″ gauges.	Total.
State lines worked by companies.	Miles	3,740	6,543	...	10,283
State lines worked by the State,	,,	4,468	599	28	5,095
Lines worked by guaranteed companies,	,,	2,588	...	...	2,588
Assisted companies, . . .	,,	183	173	72	428
Lines owned by native States and worked by companies,	,,	633	188	72	893
Lines owned by native States and worked by State Railway agency,	,,	124	...	22	146
Lines owned and worked by native States,	,,	...	804	94	898
Foreign lines, ...	,,	...	59	...	59
Total to the end of March 1897,	,,	14,736	8,366	288	20,390

The average cost per mile of railway open was as follows :—

Standard gauge, ...	Rs.158,973
Metre gauge, ...	,, 71,125
Special gauges, ...	,, 33,514

but reasons have been given in chapter xii. for regarding Rs.120,000, Rs.75,000, and Rs.30,000 as roughly the cost of representative modern lines on each gauge.

The following figures apply to the calendar year 1896 :—

Coaching earnings, ...	Rs.9,20,22,892
Goods earnings, ...	Rs.15,41,51,505
Miscellaneous, including steamboat, .	Rs.74,86,028
Gross earnings, ...	Rs.25,36,60,425
Working expenses, ...	Rs.12,19,76,875
Net earnings, ...	Rs.13,16,83,550
Passenger mileage, ...	6,427,608,140
Goods ton-mileage, ...	4,588,716,024
Number of passengers, ...	160,817,267
Tonnage of goods, etc., carried, . .	32,471,335

The percentage of expenses on gross earnings in 1896 averaged 48·09 on all lines, 47·17 on the standard, 50·56 on the metre, and 54·80 on the special gauge lines.

The statistical return on capital expenditure on open lines gives the following percentages:—

Standard gauge.	Metre gauge.	Special gauges.	Total.
5·17	5·27	7·76	5·20

Unfortunately, the State, although it could now raise money at 2½ per cent., has to pay interest to the guaranteed railways at 4¾, and to remit earnings in sterling with a rupee worth about 1s. 3d. under contracts which were made at a time when the rupee was worth 1s. 10d. The loss on this difference in rupee value alone amounted in 1895–96 to more than 100 lakhs, and the total loss on all charges appears as Rs.1,62,02,680.

What the "Railway and Canal Traffic Act" of 1888 is to English railways, the "Indian Railway Act" of 1890 is to Indian railways, and the provisions of the latter in the chapter dealing with Railway Commissions and Traffic Facilities follow very nearly the same lines as those contained in the English Act.

For example, the right of a railway to charge reasonable terminals is recognised, terminals being held to cover charges in respect of stations, sidings, wharves, depots, warehouses, cranes, and other similar matters, and of any services rendered thereat. Again, the Act places upon the railway the burden of disproving a charge of undue preference in respect of rates and services as between one trader and another. The decision in such a case is placed in the hands of a Railway Commission, consisting of one Law Commissioner and two Lay Commissioners, but this is not, as in England, a Standing Commission but one formed by the Governor-General in Council at any time that he may require.

The following are the maximum and minimum fares and rates for coaching and goods traffic laid down in the Government of India Resolution No. 563 R.T., dated the 16th of July 1891, as modified by the Government of India Circular No. 11 Ry., dated the 4th of December 1896.

PASSENGER FARES.	Maximum per mile.	Minimum per mile.
1st Class, ...	18 pies (1½d.)	12 pies (1d.)
2nd Class, ...	9 pies (¾d.)	6 pies (½d.)
Intermediate, ...	4½ pies (⅜d.)	3 pies (¼d.)
3rd Class, ...	3 pies (¼d.)	1½ pies (⅛d.)

Goods Rates.	Maximum per mile.		Minimum per mile.	
	Pies per maund.	Pence per ton.	Pies per maund.	Pence per ton.
5th Class, . .	1	2¼d.	⅙	⅜d.
4th Class, . .	⅚	2d.		
3rd Class, . .	⅔	1½d.		
2nd Class, . .	½	1⅛d.		
1st Class, . .	⅓	¾d.		
Special, . . .	⅓	¾d.	1/16	¼d.
Explosives, . .	1½	3⅓d.	⅙	⅜d.

For the purpose of expressing these approximately in English terms, the rupee has been assumed to be worth 1s. 4d. and 27·22 maunds to be equal to 1 ton.

For example, on the North-Western Railway, the fares * per mile are as follows :—

	Generally.	Mushkaf-Bolan and Sind Pishin Lines.
1st Class, ...	12 pies (1d.)	18 pies (1½d.)
2nd Class, ...	6 pies (½d.)	9 pies (¾d.)
Intermediate Class, . .	3 pies (¼d.)	4½ pies (⅜d.)
3rd Class, ...	2¼ pies (5/16d.)	3 pies (¼d.)

and the rates† per ton per mile are as follows :—

Special class goods, . .	9·07 pies.	(0·76d.)
1st ,, ,, . . .	9·07 ,,	(0·76d.)
2nd ,, ,, . . .	13·61 ,,	(1·13d.)
3rd ,, ,, . . .	18·15 ,,	(1·51d.)
4th ,, ,, . . .	22·68 ,,	(1·89d.)
5th ,, ,, . . .	27·22 ,,	(2·27d.)

The application of minimum rates and fares was considered necessary to prevent the possibility of a guaranteed railway working at rates so low that they might cause a loss to the Government from which the shareholders were protected by the Government guarantee.

English readers will perhaps be interested to know the rates between Delhi and the seaports for grain and seeds for export and for piece goods imported. The present railway distance of Delhi from Calcutta is 954 miles, from Bombay 888 miles, and from Karachi 943 miles, but when the Kotri Bridge is finished, the distance of Karachi from

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* Appendix VI., *Coaching Tariff, N.-W.R., India*, para. 24.

† Appendix VI., *Goods Tariff, N.-W.R., India*, para. 26.

Delhi will be only 906 miles. The piece-goods rate from these parts to Delhi is Rs.2 : 6 : 3 per maund. From Delhi the rate for grain and seeds is 8 annas 6 pies to Calcutta and 10 annas 9 pies to Bombay or Karachi.

The Table on p. 123 shows the passenger fares and goods rates which obtain on a few representative Indian railways; and it will be noticed that they are highest on the Jodhpore-Bickaneer (metre gauge) and Cooch Behar (2 ft. 6 in. gauge) railways, which may be regarded as light lines.

Light Railways.—The question of light railways on the narrow gauge arose as far back, at anyrate, as 1862, when Mr J. E. Wilson (Agent for the Indian Branch Railway Company) informed the Government of India that he was "prepared to enter into definite arrangements for the construction of the roadways and the laying down of light railways thereon" in Oudh and Rohilkund. In reply, the Government of India, while insisting upon the adoption of the 5 ft. 6 in. gauge for all railways intended to form portions of main lines, would sanction as a temporary expedient the construction of narrow-gauge light lines where the probable traffic was not sufficient to warrant a larger outlay, but only with the view of bringing them up to the standard in gauge and quality, when the traffic had so far developed as to require it.

The Indian Branch Railway Company deserves particular mention, because, as Mr Horace Bell observes,* "of all the numerous companies that were projected for building light railways in India, this was the only one in Northern India that actually did proceed to build lines." This Company laid a light railway of 4 ft. gauge on the public road from Azimganj to Nalhati in Bengal, but the line, after being bought by the Government of India, was relaid on the 5 ft. 6 in. gauge.

Lord Canning was very much in favour of Mr Wilson's proposals for laying light narrow-gauge lines on existing roads as feeders to the standard-gauge trunk lines. Lord Elgin, however, insisted that the proposed light lines should be constructed on the 5 ft. 6 in. gauge, and Mr Wilson was not unready to accept this decision.

Sir C. Trevelyan's protest (in a Minute, dated 4th September 1863) against the construction of any railways, light or otherwise, on any but the 5 ft. 6 in. gauge, is so interesting, not merely in regard to India, but in connection with the question of light railways in England, that one paragraph deserves quotation :—

"I have always been of opinion that a fallacy is involved in the idea of light railways. The railway experience in England is greater than that of any other country. For many years after our railway system commenced, there was a constant craving after a cheaper kind of railway. Project after project appeared for the formation of light railways or tramways, but they were all dropped. Atmospheric and other eccentric forms of railway were attempted; but, however

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* *Railway Policy in India*, by Horace Bell, M. Inst. C.E., p. 125.

Passenger Fares and Goods Rates.

Railway.	Passenger Fares in Pies per Mile.				Goods Fares in Pies per Ton per Mile.						
	1st Class.	2nd Class.	Inter-mediate.	Lowest.	Food Grains.	Coal.	1st Class.	2nd Class.	3rd Class.	4th Class.	5th Class.
Standard Gauge—											
East Indian,	18·00	9·00	3·50	2·50	3·27 to 9·07	2·72 to 9·07	9·07	13·61	18·15	22·68	27·22
North Western,	12·00	6·00	3·00	2·25	2·72 to 6·81	2·72 to 9·07	9·07	13·61	18·15	22·68	27·22
Madras,	12·00	6·00	...	2·00 to 2·50	4·00 to 10·00	3·00 to 10·00	10·00	13·61	18·00	24·00	36·00
Metre Gauge—											
Rajputana Malwa,	15·00	8·00	3·00	2·00 to 2·25	2·72 to 9·53	2·72 to 4·08	9·53	14·29	19·05	23·14	27·22
Jodhpore-Bickaneer,	18·00	6·00	...	2·00	8·17 to 10·89	10·89	13·61	20·41	25·86	31·30	36·75
2′-6″ Gauge—											
Cooch Behar,	24·00	12·00	6·00	4·00	←……27·22……→						

N.B.—Roughly 12 pies = 1 penny.

specious the light railway principle might be, there was something in it which always led to its being abandoned on close examination; and it never arrived even at the dignity of an experiment. Cheap agricultural railways are now being made in various parts of the country, but they are all solid, full-gauged railways, quite capable of bearing the rolling-stock of the main lines with which they are connected, and their cheapness arises only from their being single lines; from the landed proprietors asking moderate rates for their land, because they are convinced of the advantage to them of the railways; and from the Parliamentary expenses having been reduced to a mere trifle."

The general adoption of Lord Elgin's views, and the desire of the Government of India to adhere to the standard gauge so far as possible, are indicated in the following extracts from a dispatch,* dated April 1864, from Sir John Lawrence, Governor-General, to the Secretary of State, with reference to the negotiations between the Government of India and the Indian Branch Railway Company:—

"13. In contemplating the construction of light railways of the 5 ft. 6 in. gauge, Lord Elgin had never intended that the engines of the heavy lines should run on them. It was well understood that in England engines of one company are rarely run on the line of another, and that the practical working of railways is not compatible with such a system of interchange of engines, and that all that is ever requisite is the interchange of waggons and carriages. A 5 ft. 6 in. gauge light line was accordingly considered to mean a railway capable of carrying at a moderate speed the ordinary passenger and goods vehicles in use on the Indian main lines.

"14. Having these views, Lord Elgin authorised an arrangement being made with Mr Wilson, by which the character of the Oudh and Rohilkhund lines was to be defined, by declaring that the maximum load per wheel should be 3½ tons, and the maximum speed 15 miles an hour. This will allow of the ordinary waggon and passenger stock of the East Indian Railway running over the Oudh lines whenever the Ganges bridges are finished. To these arrangements of Lord Elgin we give our complete assent.

. . . .

"29. It only remains to us to call attention to two minutes of Sir Charles Trevelyan, in the arguments of which we have been unable to concur.

"30. In his first minute, dated 30th September last, objection is taken to the construction of narrow and light railways. So far as the present proposals are concerned, the question of narrow lines does not arise. But we are not prepared to recede from the position before taken up by the Government of India in respect of such lines, viz.: That when nothing better can be got, and with due provision for their resumption and conversion into full-gauge lines when the traffic calls for the change, the Government may, without objection, aid such lines, in each case determining the amount of aid with reference to the objects to be attained.

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* *Railway Policy in India*, by Horace Bell, M. Inst.C.E.

"31. As regards light lines, very nearly the same remarks will also apply. As soon as the Government gives up the system of guarantee, and abandons all right or desire to interfere in the management of railway companies' affairs, it ceases to be in a position to decide whether a line shall be constructed of rails of one class or another. Such a matter is essentially one for the company to determine. What the Government can do is to decline giving assistance, unless certain terms are offered by the companies, as the companies can refuse to accept the assistance offered if it be too little to satisfy them. The Government of India has adopted the conclusion that a 5 ft. 6 in. gauge line, of such a character as will admit of the carriage and waggon stock of the great lines going over it at a moderate speed, will probably be, for many years to come, sufficient to meet the requirements of the country, and this general standard it has taken as the minimum for the full-gauge lines."

As a result, the Oudh and Rohilkhund Railway—which included and absorbed the Indian Branch Railway Company of that time—was constructed on the standard 5 ft. 6 in. gauge.

The Indian Tramway Company meanwhile was putting forward proposals for narrow-gauge light lines in Southern India, and constructed a railway on the 3 ft. 6 in. gauge between Arconum and Conjeveram in 1865, which—after being made part of the South Indian railway system in 1874—was converted to metre gauge in 1878.

The immediate importance of increased railway communication at a minimum first cost induced Lord Mayo to construct the Rajputana-Malwa Railway on the metre gauge. The rails originally used were of iron, 36 lbs. and 40 lbs. to the yard, laid on transverse sleepers of deodar and creosoted pine. As first conceived, it was a light railway directed from Delhi to the Sambhar Lake and salt works. The rail weighed 36 lbs. per yard, the width of formation was 12 feet, and the maximum axle-load was 4 tons for waggons and 6 tons for engines; while the speed, limited to 15 miles an hour, scarcely exceeded 10. All that the Government of India claimed then was "the sufficiency of a narrow gauge to carry our secondary lines." But when the Rajputana Railway was extended to Ahmedabad, where it made connection with the standard gauge Bombay, Baroda, and Central India Railway, it occupied the longer portion of the direct route from Delhi to Bombay. The quality of the line had, from the beginning, been first-class; and when it became necessary to adopt a 50 lb. steel rail as the standard, 14 ft. and 16 ft. as the width of formation, a maximum axle-load of 12 tons for wagons and of 15 tons for engines, and a speed of 25 miles an hour, its claim to be regarded as a light railway in any sense of the word had vanished. It may be mentioned that the line from Delhi to the Sambhar Lake was open for traffic on the 1st March 1875. The extension to Ahmedabad was not completed until the end of 1879.

In 1870 the whole question of gauge for light railways was the subject of keen debate in England, and the state of the case in India was described by Mr W. T. Thornton in a paper read before the Institution of Civil Engineers on the 4th February 1873. The recommendation by Col. Strachey, Col. Dickens, and Mr Rendel to regard 2 ft. 9 in. as the alternative to the standard gauge is justified to-day by the increasing development of 2 ft. 6 in. gauge lines, and had their advice been followed, the continuity of standard gauge on main routes would have been assured.

Lord Northbrook wished to lay the Indus Valley and Punjab Northern Railways with light 60 lb. rails on the 5 ft. 6 in. gauge. The Duke of Argyle, who was then Secretary of State, was strongly in favour of the metre gauge being adopted as being both adequate and suitable; but he was ready to accept the standard gauge if a 45 lb. rail were prescribed. Lord Salisbury, however, having succeeded the Duke of Argyle as Secretary of State, was of the same mind as Lord Northbrook in regard to both rail and gauge. Accordingly the Indus Valley Railway was constructed on the standard gauge, while so much of the Punjab Northern as had been laid between Lahore and Jhelum on the metre gauge was converted to standard, and the extension to Peshawar was carried out on the same scale. The works on the Grand Trunk road between Lahore and Wazirabad were also abandoned, and the railway placed on an independent alignment.

In 1880 Lord Lytton suggested that the Provincial Governments should undertake the construction of cheap and light railways on their own financial responsibility, as distinct from that of the Imperial Government, and during the next three or four years the subject was discussed between the Punjab Government and the Sind, Punjab, and Delhi Railway. This line was taken over from the company by the State on the 1st of January 1886, and thenceforward became part of the North-Western State Railway, under the management of Col. Conway-Gordon, R.E., who at once addressed the Punjab Government with reference to this important question of the construction of light railways in the Punjab.

Anticipating that, on so large a system as that under his management, the annual renewals of rails might average about 100 miles, Col. Conway-Gordon proposed to utilise these second-hand rails for the purposes of light railways. Although second-hand rails which were unfit for the main line would be equally useless for branch lines, if the latter were constructed as first-class railways, they would serve excellently for light railways or tramways, and he considered that light railways or tramways only were necessary for opening up the country in the first instance. Wherever, therefore, the Punjab Government were of opinion that a branch line would be useful for opening up a district or for connecting any important town with the North-Western Railway system, a cheap surface tramway should, he suggested, be laid down, without platforms, stations, or any other expensive conveniences, the object being, in the first instance, to get the metals linked through and the traffic started with a minimum of expenditure. In short, the branch should be regarded simply as a tram, not a railway, and designed for a speed of not more than ten miles an hour. He proposed that the North-Western Railway should give old rails, sleepers, etc., and that the Punjab Government should give the land and furnish the small cash expenditure necessary to lay down the line. The North-Western Railway should work the line as cheaply as possible, debiting the revenue account with actual expenditure only, and the net earnings should be paid over to the Punjab Government until their expenditure, without interest, had been recouped. After that the branch should be considered a part of the North-Western Railway, and the net earnings devoted to the improvement of the line until it reached the general standard of other North-Western branches. Col. Conway-Gordon hoped that the expenditure thus required of the Provincial Government would not be more than Rs.2000 or Rs.3000 a mile to lay down such lines and open them for traffic.

The Government of India in 1887, when Col. Conway-Gordon had become Director-General of Railways, reverted to these proposals, and observed that, as a first experiment, two important towns should be selected, connected by a road wide enough to admit of the tramway being laid on the side of the road. The 2 feet steam tramway at Ferozpore was quoted as a successful example of a line on this plan. It will be noticed that in 1886 Col. Conway-Gordon appeared to be in favour of light lines on the standard gauge, but in 1887 was disposed to adopt a smaller gauge where the lines could be laid on roads.

In 1890 the writer (then executive engineer, Multan division, N.W.R.) was asked to submit a rough estimate of the cost of laying a light railway from Montgomery (on the North-Western Railway) to Pakpattan. After riding over the proposed route, the writer estimated that such a line could be made for Rs.480,483 or (the length being 28 miles) Rs.17,160 per mile. Nothing was put down for preliminary expenses, as so short and easy a line could be laid out by the Multan divisional staff, and the land, which was mostly waste, would be given by the Punjab Government, but the value of the second-hand permanent-way material was included thus:—

	Rs.
39.60,000 c. ft. earthwork, ...	15,840
Bridges and culverts—	
4 rail openings, 2 ft., at Rs.500 each, . . .	
9 rail openings, 5 ft., at Rs.1000 each, . .	
2 canal bridges, 3–8 ft., at Rs.3000, . . .	17,000
Ballasting, 633,600 c. ft. (only 4 c. ft. per foot run), .	63,360
Permanent-way, second-hand, 30 miles, . . .	284,730
Stations and offices, ...	5,000
Supervisional charges, etc. at Rs. 24½ per cent., . .	94,553
	Rs.480,483

The prospects of this line were not so favourable as to induce the Punjab Government to undertake its promotion.

In 1891, at the request of Col. Wallace, R.E., director of the North-Western Railway, the writer submitted a note on "Feeder Lines in the Punjab and the New North-Western Route between Delhi and Karachi." Attention was drawn to the rapid development of canals in the Punjab by the Irrigation Department without any corresponding development of feeder railways to tap the districts opened up to wheat cultivation and gradually being colonised. It was pointed out that, with second-hand material from the main line, such light railways could be, and that from Wazirabad was being, constructed at a cost of Rs.18,000 to Rs.20,000 a mile. The profits contributed by branch to main lines generally were discussed, and the direct and indirect benefits likely to accrue to the province of the Punjab, the North-Western Railway, and the canals from the construction of certain minor branches and connections on the light railway principle were described. At the same time particular notice was taken of the possibility of some of these lines being effective, in the first instance, as local railways and feeders only, but, ultimately, as forming part of direct main routes. The three projects particularly alluded to were the Chord line from Wazirabad to Multan, that from Rohri to Kotri, and that from Bahawalpur to Delhi. The two latter have just been completed as first-class railways, the Rohri-Kotri line by the State and the Southern Punjab line by a company. The North-Western route from Delhi to Karachi by these two Chords is thus reduced to 906 miles, as against 888 miles by the B.B. and C.I. route from Delhi to Bombay, and 954 by the East Indian to Calcutta. The line from Wazirabad to Khanewal is under construction in accordance with light railway principles, as indicated by Col. Conway-Gordon, but the actual cost of construction is nothing like so low as he estimated.

The object of this line is to open up the country now watered by the Chenah Canal. Settlers from other parts are reclaiming the desert land as it becomes fertilised by the supply of canal water, and the railway will provide the means for exporting grain and other produce. The branch was completed as far as Lyallpur in February 1896, the permanent-way consisting of second-hand rails and sleepers obtained from the renewals of the main line. In the first instance, only one-fifth of the full section of ballast has been spread. Girders for all bridges have been furnished from the old stock of the North-Western Railway. The extension to Khanewal will be practically a surface line, with maximum grades as flat as 1 in 400. The actual cost of the Wazirabad-Lyallpur section, including rolling-stock, was Rs.38,78,000 for 95·68 miles. The sanctioned estimate for the extension from Lyallpur to Khanewal amounts to Rs.27,00,000 for 105 miles, without rolling-stock.

In 1889, Colonel Conway-Gordon, as Director-General of Railways, attempted once more to have precise and definite rules laid down on the question of gauge. The Secretary of State, however, was well advised in leaving the question an open one, to be decided in each particular case by the Government of India. The merits of the 2 ft. 6 in. gauge as that to be adopted in hill country or in special cases where continuity of gauge is either impossible for physical reasons or unimportant for traffic purposes, have recently been practically appreciated.

In 1896, the Government of India issued a circular—Government of India, Railway Branch, P.W.D., No. 514 R.C. of 1896, dated 17th April 1896—in which they described the encouragement and assistance they were prepared to give to private enterprise in the promotion of branch lines.*

The Government of India cancel previous resolutions and summarise the concessions they are prepared to give for the construction of branch or feeder railways, not, as a rule, to exceed 100 miles in length, larger or more important railways and mountain branches being excluded.

The main line administrations interested will have a prior right to construct branch lines forming feeders.

The Government of India will publish lists of branch lines, for the construction of which they are prepared to accept tenders, and will consider the inclusion in the lists of such lines as may be suggested by others.

Applicants must be able to command financial support; the gauge must be approved; the railway shall be subject to the Indian Railways Acts; the alignment, etc., must be approved, and the railway be built in accordance with standard dimensions; the line, while under construction, shall be subject to Government inspection; and financial assistance may be afforded by the Government of India, either as—

(*a*) An absolute guarantee of a minimum dividend (not exceeding 3 per cent.) in rupees (on capital expenditure in rupees), with such share of surplus net profits as may be agreed upon; or

(*b*) A payment by the main line sufficient—with the branch company's share of branch earnings—to give the company a dividend of 3½ per cent. on capital expenditure in rupees, but in no case to exceed the net earnings of the main line on interchanged traffic; all net earnings of the branch over 3½ per cent. to go to the company.

In either case—(*a*) or (*b*)—capital raised in sterling will be entered in the company's books in India in rupees at the actual rate and time of remittance, together with English outlay from time to time at the Secretary of State's average rate for the preceding half-year.

The general character of the supervision and control of the Government is then defined, in regard to capital expenditure, increase of share or stock capital, permission to borrow, accounts and statistics, audit, etc.

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* Appendix VII.

Funds for new capital works, required after opening, must be provided by the company.

State railways' regulations regarding rates and services will apply.

The additional concessions admissible are then stated. These include:—

(1.) The charge of interest during construction;
(2.) The free grant of land (but not of land required for quarries, ballast, brickfields, etc.);
(3.) The supply and maintenance of electric telegraphs by the Government of India at the usual charges;
(4.) The free use of results of existing surveys, and the preparation of fresh surveys on deposit of estimated cost;
(5.) The construction of the branch by the main line, and its maintenance and working by it at a fixed ratio of expenses to earnings, the ratio not to exceed 50 per cent., and to include charges for the use of the main line stock;
(6.) The incidence of expenses on account of the Board of Direction;
(7.) The carriage of railway materials for the branch over State lines at the special rates.

The Government of India reserve:—

(1.) The right to purchase the branch for twenty-five times the yearly average net earnings (not including rebate payments of the preceding three years) at the expiry of twenty-one, thirty-one, forty-one, etc., years, on twelve months' notice, with a maximum price of 120 and a minimum of 100 per cent. of cost price on a rupee basis;
(2.) The right to fix and vary the classification of goods and maximum and minimum rates of each class of goods and passengers; and
(3.) A general control in respect to the number and timing of trains.

Several railways have been sanctioned under the branch line terms laid down in the resolutions of 1893, 1895, and 1896. One or two have been completed, and others are in course of construction.

The Barsi Light Railway runs from Barsi Road—a station on the Great Indian Peninsula Railway, 234 miles from Bombay—to the town of Barsi, a distance of 21·75 miles. It was originally sanctioned as a steam-tramway project in December 1892; but, the promoters having appealed to the Secretary of State regarding certain terms contained in the order authorising its construction, he decided to treat it as a light railway project under the Indian Railways Act, and to offer to the promoters the feeder line terms of 1893 with certain modifications. The contract was executed on the 1st August 1895.

By way of assistance, the company was to be allowed to use the road between Barsi Town and Barsi Road Station for the construction of a single line of railway. Any land required outside the road was to be acquired through the collector of the district, all expenses being borne by the company. The road had been constructed by the Government of Bombay in 1870 for the purposes of a light railway, with maximum gradients of not more than 1 in 100.

Government may determine the contract on 1st January 1917, or at the expiration of any subsequent period of ten years, by giving twelve months' notice. If the contract is so determined, the Government is to pay to the company in England in sterling an amount equal to the total paid-up capital, so far as such capital shall have been expended with the authorisation of the Secretary of State.

The following are the maximum rates and fares. It will be noticed that the rates are about twice as high as those obtaining on the main lines, and that the fares also are considerably higher. The necessity of permitting a wider margin on short lines of this kind is obvious:—

Passenger fares.	First-class, 24 pies per mile.
	Second-class, 12 pies per mile.
	Third-class, 8 pies per mile.
	Fourth-class, 3 pies per mile.
	Luggage, 4 pies per maund per mile.
	Horses, each, 24 pies per mile.
	Carriages, each, 4 annas per mile.
	Dogs, each, 8 annas per 50 miles.
	Parcels, under 7 seers, for first 50 miles, 6 annas, beyond, 3 pies per seer for every 50 miles.
Goods rates.	Fifth-class, 54 pies per ton per mile.
	Fourth-class, 36 pies per ton per mile.
	Third-class, 24 pies per ton per mile.
	Second-class, 18 pies per ton per mile.
	First-class, 12 pies per ton per mile.
	Food grains, 12 pies per ton per mile.
	Coal, 10 pies per ton per mile.

A maximum terminal charge of 1 anna per maund is allowed on all goods traffic, leviable both at receiving station or at station of delivery. Traffic booked through not liable for terminals at junctions.

The rates and fares are to be such as may from time to time be agreed upon between the Government and the working agency, subject to the conditions that they are to be within the maximum and minimum rates and fares in force on the East Indian Railway, and that the classification of goods is to be in accordance with that on the East Indian Railway.

The Barsi Light Railway was constructed on the 2 ft. 6 in. gauge, and was opened for traffic in March 1897. One side of the district and municipal roads was made over for laying the railway, which occupies a width varying from 6 ft. 3 in., where the line follows the gradient of the road, to 9 ft. or so, where the line rises to take the bridges. A roadway of 12½ ft. or more is left for carts on the bridges, and is railed off from the railway. The sharpest curve has a radius of 450 ft., and the steepest gradient is 1 in 88 for a length of half a mile. The permanent-way consists of 35 lb. steel, flat-footed rails and steel sleepers, with 7 cubic feet of broken stone and moorum ballast to the foot run. The fish-plates, weighing 12½ lbs. per pair, are 16 in. long, with four holes spaced 4 in. apart, centre to centre. The fish-bolts are ½ in. in diameter, with square necks, cup-shaped heads, nuts 1 in. square and $\frac{9}{16}$ in. deep, and Grover's patent washers. The steel sleepers are 5 ft. 6 in. long, 6 in. wide, and 3½ in. deep, weigh 50 lb. each, and are laid 10 to the 24 ft. rail, the rail being fastened in the clips by steel keys, two of which are driven on the straight, and four with the B sleepers used on curves to allow widening of gauge as required. On bridges wooden sleepers are used, every third sleeper being fastened down to the girders by two hook-bolts, and the rail is secured to the sleeper by $\frac{5}{8}$ in. dog-spikes.

The engine and rolling-stock are described in Chapter XIV. The engine is expensive and heavy, bringing a weight of nearly twenty tons on a wheel-base of 8 ft. 3 in. This throws on each sleeper a maximum load greater than that on the metre gauge, and the cost of maintenance will probably be high, even if the speeds are kept low.

The arches of the road bridges were not strong enough to carry this stock, and steel girders were specially designed as for metre gauge, and erected on the abutments and piers, 3 in. clear of the road arches. This added considerably to the cost of construction.

The expenditure up to 30th June 1897 on this line was £77,986, or £3585 a mile, which is a far higher figure than in the case of the Gaekwar's Dabhoi, the Cooch Behar, the Morvi, and other Indian lines constructed on the 2 ft. 6 in. gauge (Appendix IV.). In fact, it has been constructed, and equipped with rolling-stock, as a first-class railway on a narrow gauge.

The gross earnings for 17·4 weeks (March to June 1897) were Rs.55,347, or about Rs.150 per mile per week, a very satisfactory figure for a new line, and it was expected to reach Rs.230 per mile per week in the following year.

The Barsi Light Railway is to be extended to Pandharpur. The survey was carried out by Government, and the earth-work undertaken as a famine relief work.

The Ahmedabad-Parântîj metre-gauge line was opened for traffic to Talod in May, to Parântîj in July, and to Idar Ahmednagar in October 1897. Its length is 54·80 miles. The permanent-way consists of 41¼ lb. flat-footed steel rails on deodar sleepers. There are two bridges, one of six spans, the other five spans, of 60 ft. The ruling gradient is 1 in 200, and the limiting radius of curve 1000 ft.

When the negotiations with the B.B. and C.I. Railway for the construction of this railway fell through, Messrs Killick, Nixon, &

Co., of Bombay, applied for a concession to take up the project on feeder-line terms, offering to construct the line with rupee capital. This offer was accepted by the Secretary of State, and, a concession having been given to the applicants, work was started in January 1896. The line was constructed by the B.B. & C.I. Railway Company, and is worked by them as a part of their metre-gauge system.

Land was granted free, and the following were the terms made with the Ahmedabad-Parântîj Railway Company:—

Government undertakes to construct (from funds supplied by the company), work, and maintain the line, through State or other agency, the necessary rolling-stock being supplied by the working agency. (The agency selected is the B.B. & C.I. Railway Company, with which an agreement for the purpose was entered into by Government in 1896.) The charge to the Ahmedabad-Parântîj Company for the working, stocking, and maintenance of the line is to be calculated half-yearly at the same percentage of gross earnings as obtains on the Rajputana-Malwa undertaking, but it is provided that the charge shall not in any year exceed 50 per cent. of the gross earnings for that year. The residue of the gross earnings, after deduction of the charge for working, etc., is payable to the A.P. Company.

By agreement with the B.B. & C.I. Railway Company, the Government will allow to the Ahmedabad-Parântîj Company, in respect of each calendar year, by way of rebate, such a sum, not exceeding 10 per cent. of the combined shares attributable to the B.B. & C.I. and Rajputana-Malwa Railways of the gross earnings from traffic interchanged between those railways, or either of them, and the A.P. Railway, as will, together with the net earnings of the A.P. Company, make up an amount equal to interest for the year at the rate of 4 per cent. per annum on the actual capital expenditure. The Government will also allow the Company the sum of Rs.5000 per annum towards the Company's office expenses and expenses of management.

Rates and fares are to be such as may from time to time be arranged between the Government and the working agency, but it is provided that they shall be within the maximum and minimum rates and fares for the time being in force on the R.M. Railway. The classification of goods is to be in conformity with that in force on the R.M. Railway.

Government may determine the contract if, before the line is open for traffic, the company fail, on demand, to supply the funds required for its completion. In case of such determination the Government will pay the company in rupees the fair value of the railway, works, and stores given up.

Government may also, by giving twelve months' notice, determine the contract—

(1.) On the 31st December 1917, or at the end of any subsequent period of ten years. In this case the Government undertakes to pay to the company in rupees a sum equal to twenty-five times the average yearly net earnings of the company during the last preceding five years, provided that such sum shall not exceed by more than 20 per cent. the total capital expenditure of the company, nor be less than such capital expenditure; or

(2.) On the 31st December 1946. In this case the Government will pay to the company in rupees an amount equal to the total capital expenditure.

In 1894 or 1895, Mr James Currie, of Karachi, applied for a concession, on branch-line terms, for the construction of the Ahmedabad-Dholka section (32 miles), of the Ahmedabad-Dholera Railway (78 miles) on the metre gauge. The matter was said to be under consideration.

During the year 1896–97 work was started on the following railways, which were sanctioned under the "branch line terms" resolutions of 1893, 1895, and 1896:—the Tapti Valley (standard gauge) Railway, the Segowlie-Raksaul (metre gauge) Railway, the Hardwar-Dehra (standard gauge) Railway, the Mymensingh-Jamalpur-Subhankhali (metre gauge) Railway, and the Sultanpur-Bogra-Kaliganj (metre gauge) Railway. The two last are in connection with the Eastern Bengal State Railway system.

The Tapti Valley Railway will connect Surat on the B.B. and C.I. Railway with Amalner, the present terminus of a branch from Jalgam on the G.I.P. Railway, the length being 162·47 miles. Work was commenced in November 1896, and is progressing rapidly.

The line from Segowlie, on the Tirhoot section of the Bengal and North-Western Railway to Raksaul, on the borders of Nepaul, is on the metre gauge, and 18 miles long. Work was commenced in May 1896, and it was expected that the line would be opened for traffic before the end of 1897.

The alignment for extending the Hardwar branch of the Oudh and Rohilkhund State Railway to Dehra was finally located in January 1897 on behalf of the company by whom it is to be constructed. There will be as much as 1600 ft. of tunnelling in it. The length of the line is 34 miles.

The two lines connected with the Eastern Bengal State Railway system are being constructed by State agency on behalf of the branch-line companies, and will be worked by the railway. The Mymensingh-Jamalpur-Kaliganj is an extension of the Dacca section towards Sirajganj. The Sultanpur-Bogra-Kaliganj line will tap the Assam traffic at an important point on the Brahmaputra River.

Other developments of the Eastern Bengal State Railway, which may attract private enterprise, are a metre-gauge line from Panchabibi eastward through Gaibanda to Kaliganj, and another westward to Gazol, which is on the route of a third line from Ranaghat to Rayganj. This last should be broad gauge from Ranaghat through

Moorshedabad to Bhagwangola, and metre gauge from the Ganges through Gazol to Rayganj, running northward all the way. Other extensions which might be made are from Nator to Rampur Boalia, from Phulbari to Sumjhia, from Saidpur to Titalyah, from Rangpur directly north to the Teesta River, and from Lalmanir Hat to Dhomani, all on the metre guage; from Dacca westward to Sealo, to complete the gap in the railway communication at present filled by steamers on the Pudda and Megna Rivers; and a broad-gauge extension from Rajbari to Faridpur.

In addition to the above a survey was made in 1893 for a branch from Nelphamari on the E.B.S. Railway to Jayganj, a distance of 8½ miles, at the request of a native gentleman who proposed to form a company and obtain a concession for the construction of the line. The concession was granted in 1895. The cost of construction was estimated at about Rs.24,819 a mile, and the traffic prospects were considered favourable.

The Cooch Behar State Railway—worked for the Maharaja by the Eastern Bengal State Railway—is being extended to the capital, and will no doubt be carried on to Santrabari before long.

It appears from the Administration Report for 1897–98 that not a single new railway was sanctioned during the year under the branch line terms of 1896, although as many as fifteen schemes were under consideration.

For purposes of comparison, a table (compiled from the Director-General of Railways' Administration Report for 1894–95) will be found in Appendix IV., giving for certain railways the mileage, the cost, the gross earnings, working expenses and net earnings, the amount of passenger and goods traffic; the train mileage and the quantity of rolling-stock. In the chapter on "Light Railways in Belgium," moreover, the cost of certain lines in India has been analysed and compared with the Belgian figures, the object being, as far as possible, to eliminate from the inquiry such exceptional lines as the Rajputana-Malwa Railway and the Darjeeling-Himalayan, and, above all, to destroy the impression that our examples of light railways must necessarily be taken from lines constructed on a metre or narrower gauge. As fair examples of Indian lines constructed in accordance with light railway principles, the following may be mentioned:—

(*a*) *Standard gauge:* Wazirabad - Lyallpur (actual cost, Rs. 40,531 per mile, including rolling-stock); Lyallpur-Khanawal (estimated cost, rolling-stock not included, Rs.25,714 per mile); Hyderabad - Shadipalli (Rs.30,112 per mile); Sialkot Branch, N.W.R. (Rs.30,000 a mile, with second-hand rails and sleepers, no bridging, but expensive stations); Ganda Singh Branch, N.W.R. (Rs.33,000 a mile, with second-hand rails and new sleepers, cheap stations, but considerable bridging).

(*b*) *Metre gauge:* Rohilkund and Kumaon (two sections, Rs.38,353 and Rs.37,858 per mile); Palanpur - Deesa (Rs.24,175 per mile); Cawnpore-Burhwal (Rs.21,550 per mile); Jodhpore - Bickaneer (two sections, Rs.20,141 and Rs.22,375 per mile); Oodeypore - Chitor (Rs.25,894 per mile); Gaekwar's Mehsana (Rs.35,209 per mile); Jetalsar-Râjkat (Rs.32,939 per mile).

(c) *Special gauges:* Jorhat, 2 ft. (Rs.29,029 per mile); Gaekwar's Dabhoi, 2 ft. 6 in. (Rs.26,306 per mile); Cooch Behar, 2 ft. 6 in. (Rs.33,450 per mile); Morvi, 2 ft. 6 in. (Rs.24,220 per mile); Kaunia-Dharlla, 2 ft. 6 in. (Rs.24,929 per mile).

The exceptional physical difficulties which had to be overcome in the construction of the Darjeeling-Himalayan Railway sufficiently account for the high cost per mile of this 2 ft. line, Rs.61,792; and it would be unfair to quote this as a normal figure for so small a gauge. Moreover, if the cost of the 2 ft. 6 in. Barsi Light Railway (£3585 per mile) may be expressed as Rs.53,775 per mile (taking Rs.1 as equal to 16d.), it would seem that narrowness of gauge is its main claim to be classed as a light railway.

Steam Tramways.—In addition to railways, there are in India 119½ miles of steam tramways working outside municipal limits and 104 miles under construction. Included in the latter are the Rânaghât-Krishnagarh (2 ft. 6 in.), Mangaldai (2 ft. 6 in.), Howrah-Amta (2 ft.), and Howrah-Sheakhalla. In fact, the last two have since been completed by Messrs Martin & Co. on behalf of the Bengal District Roads Tramways Company, and there seems to be a large field for undertakings of this description in Bengal.

The Howrah-Amta line is twenty-nine miles and the Sheakhalla line twenty-two miles long. The stations are about two miles apart, so that traffic can be dealt with at frequent intervals. Within the limits of Howrah speed is limited to six miles an hour and in the district to ten.

With the liberal terms now held out by the Government of India to companies formed for the construction of light railways, the only obstacle to the attraction of British capital is the fluctuations in exchange. English capitalists are afraid to risk money in India, which may be returned to them at a heavy loss. If, as the Secretary of State holds out hope, a gold standard be established, fixing the stable exchange of the rupee at 16d., subject only to the fluctuations of trade, British capital will find a profitable investment in the development of light railways in India.

CHAPTER IX.

LIGHT RAILWAYS IN IRELAND.

CONTENTS.—Irish railways assisted by Treasury loans—Baronial guarantees—Tramways Acts of 1860, 1881, and 1883—Light railways constructed under these Acts—Too expensively constructed and worked—Not controlled by local authorities who had to bear the losses—Light Railways Act of 1889 a boon to main line companies and the people—Light railways constructed with State assistance under the Act of 1889 and 1890—Railways Act of 1896 compared with the English Act of 1896.

Light Railways Constructed under the Acts prior to 1889.—Ireland, in the development of her railway systems, has never been able to preserve the same independence of State aid which has hitherto been so remarkable in England and Scotland. From the very first, the Treasury has advanced money to railway companies, usually on the security of a mortgage on the undertaking, and the Government has not claimed, in consequence of affording this assistance, to exercise any more control over the details of working, rates, etc., than in the case of other railways. Up to 1888, according to returns submitted to the Royal Commission held in that year, as much as £4,101,401 had been thus advanced; of this amount £2,921,414 had been repaid by the railways, £37,772 had been remitted by the Imperial Government, and the remainder was outstanding. Up to 1893, the Treasury loans had reached £4,197,746, of which the railways had paid back £3,383,278.

The railways also received public assistance in the form of guarantees of interest, secured upon the rates, by the baronies or local authorities of the districts traversed by the railways; and here, again, the public bodies assisting did not, therefore, interfere with the service or rates, although they were generally represented by one or more members of the Board of Directors nominated by them.

To such aid from the State and local authorities must be added, in many instances, the privâte aid of landed proprietors in the form of subscriptions of capital or guarantees of interest.

In the poorer districts, however, when railways were often urgently required, there was little to attract capital, and legislation had not been favourable to the construction of light lines.

By the Tramways Act of 1860, the compulsory acquisition of land was provided for, but projects had first to be submitted to the Grand Jury, then to the Lord-Lieutenant in Council, and finally to Parliament for confirmation by an Act. The last formality was dispensed with in the following year. By the Tramways Amendment Act of 1871, mechanical traction at a maximum speed of six miles per hour on roads and of three miles per hour in towns was permitted, and the maximum speed on roads was increased to ten miles per hour in 1881. But much more important than all these was the Tramways and Public Companies Act of 1883, the intention of which was, first of all, to throw the responsibility of railway development in poor districts upon the local baronies, and then, perhaps, to share it with the Imperial Government. Thus promoters would submit a project for a light railway to the Grand Jury, and the ratepayers might oppose it. The approval of the Grand Jury would throw upon the rates of the whole country, or of so many baronies, charges, not for the interest only, but for deficits on working expenses, and even the obligation of working the line if it was abandoned by the promoters. On the other hand, although the Grand Jury might nominate a director or appoint an auditor, it had no real control over the railway, so long as it was run by the promoters. The project further required the acceptance of the Privy Council, and, if opposition was still maintained, the confirmation of an Act of Parliament. The last carried with it the obligation to repay the Grand Jury, either (*a*) interest on capital to the extent of 2 per cent., or (*b*) half the difference between the net receipts and the total guaranteed interest required, whichever might be smaller.

Under the Tramways (Ireland) Acts, 1860 to 1883, have been constructed (excluding three or four lines worked by one or other of the great railway companies) 230 miles of light railways. They * show total receipts of £55,625 (about £240 per mile), a total working expenditure of £57,856 (about £252 per mile, or 104 per cent. of receipts), and a deficiency of £2231 (or £9·7 per mile) by way of net receipts. The local ratepayers (with the exception of about £25,000 per annum falling to the charge of the Imperial Government) have to make good this deficit, and the whole of the interest on capital. If we look up the Mitchelstown and Fermoy Light Railway in the returns, we find that, of a 5 per cent. rate of dividend, 2 per cent. is guaranteed by the Imperial Government and 3 per cent. by the baronies of Condons and Clongibbons. The total capital of all these light railways (including those worked by the great companies) is £1,310,905, of which no less than £1,199,175 is guaranteed, either at 4 or 5 per cent.

The following have been quoted as the more favourable in their results of these light railways, and figures relating to them are given in the table below,—the Clogher Valley, Cork and Muskerry, Schull and Skibbereen, and the Tralee and Dingle.

The Clogher Valley, 37 miles long, cost £3286 per mile, and shows receipts of £6850, against an expenditure of £6889. The Cork and Muskerry, 18 miles long, cost £4167 per mile, and shows receipts of

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* *Railway Returns*, 1896.

£9472, against an expenditure of £7866. The Schull and Skibbereen, 15 miles long, cost £3800 per mile, and shows receipts of £2306, against an expenditure of £3368. The Tralee and Dingle, 37 miles long, cost £4054 per mile, and shows receipts of £5891, against an expenditure of £9341. Thus, the proportions per cent. of expenditure to receipts on these four lines are 104, 83, 146, and 159, and the Cork and Muskerry Light Railway is the only one that can boast of net receipts in the returns for the year 1896.

Working Expenditure, Net Receipts and Rolling-Stock of Light Railways authorised under the Tramways (Ireland) Acts, 1860 to 1883.			Clogher Valley.	Cork and Muskerry.	Schull and Skibbereen Tramway and Light Railway.	Tralee and Dingle.
Length of Line in miles open		No.	37	18	15	37
Maintenance of Way and Works	Working Expenditure.	£	1329	1746	999	4017
Locomotive Power		,,	2529	2371	1081	2319
Repairs of Carriages and Wagons		,,	573	593	319	411
Traffic Expenses		,,	1465	1996	557	1580
General Charges		,,	743	592	318	653
Rates and Taxes		,,	70	43	9	44
Compensation for Goods		,,	19	14	Nil.	7
Legal and Parliamentary		,,	31	3	85	35
Miscellaneous		,,	130	508	Nil.	275
Total Working Expenditure		,,	6889	7866	3368	9341
Total Receipts		,,	6850	9472	2306	5891
Net Receipts		,,	−39	1606	−1062	−3450
Proportion per cent. of Expenditure to Receipts			101	83	146	159
Locomotives		No.	6	5	4	5
Carriages, Wagons, Trucks, etc.		,,	95	78	54	50

The cost per mile of the four lines mentioned is in each case much less than the average cost per mile of all these light railways, which is about £5700, a heavy price to pay for a 3 ft. gauge line. They are too substantially built and too expensively worked, in accordance with Board of Trade traditions, for lines with such poor average traffic receipts as £239 per mile. The heavy expenses, due to the complicated preliminary procedure and the purchase of land, absorbed so much capital that none was left for profitable expenditure on purposes absolutely necessary to the development of traffic. The administration of small lines as separate concerns is always expensive, and the Act of 1883 had expressly ignored the great railway companies. Above all, the local authorities, who had to stand all risks and bear all losses, had no proper control over the petty companies who constructed and worked the lines; the baronies were saddled with all the liabilities, but were armed with none of those powers which should accompany responsibility.

Accordingly, the Royal Commission on Irish Public Works—to which reference has already been made—in 1888 reported that the preliminary procedure was expensive and complicated, that the local authorities ought not to be liable for working expenses as well as interest on capital, that the ability to promote such lines should be extended to existing railway companies, that the adoption of a narrow gauge was unduly encouraged, and that the tendency should rather be to develop light railways on the standard gauge.

Light Railways Constructed under the Acts of 1889, 1890, and 1896.—While the Act of 1883 expressly ignored the great railway companies in relation to tramways or light railways, the Light Railways (Ireland) Act, 1889 [52 & 53 Vict.], applies most particularly to them. The promoters (*a*) may be an Irish railway company having a railway open for traffic, or (*b*) may have an agreement approved by the Treasury for the working of the light railway by such a railway company, or (*c*) may apply, under the provisions of the Act of 1883, for a baronial guarantee on a portion of the paid-up capital of the light railway. The Treasury might aid such an undertaking either with a free grant or a loan, but would not pay in the aggregate more than £20,000 a year in addition to the residue, if any, remaining unappropriated of the £40,000 a year mentioned in the Act of 1883; nor should any capital sums granted exceed £600,000 in the aggregate; annual grants, moreover, should be reduced in limit by 3 per cent. on any capital grants; and capital grants would be similarly reduced by any excess of annual grant, over and above the £42,000 a year mentioned above, capitalised at 3 per cent. It lay with the Lord-Lieutenant in Council to declare that a light railway should be constructed between certain places for the development of fisheries or other industries, that special assistance from the State was required, and that the application of the Act should cease if the light railway were not constructed within a certain period.

No doubt this Act, followed by the Railways (Ireland) Act, 1890, and the Transfer of Railways (Ireland) Act, 1890—the last of which enabled existing companies to take over a light railway company, *with* the baronial guarantee—were exceedingly favourable to the main line companies. The latter made extensions to their own lines upon the easiest terms under these Acts. Of twelve light railways aggregating 237 miles, towards the construction of which State assistance has been given in the form of free grants unaccompanied by any embarrassing conditions, all but one—the Donegal and Killybegs, a 3 ft. gauge line—have been constructed on the normal Irish gauge, 5′ 3″, and nearly all are worked by such railway companies as the Midland Great Western, the Great Southern and Western, the Cork, Bandon, and South Coast, etc. But they reach important fishing grounds, more especially on the west coast; they penetrate to the poorest districts in Donegal, Mayo, Galway, Kerry, Cork, Down, and Sligo; and, if the main lines profit by the contributive traffic of lines for which the State and the baronies have provided the capital, the people of these districts reap also the full advantages of long-needed railways under the efficient management of the great railway companies. That the latter are fairly prosperous may be conceded, seeing that their average return on all descriptions of capital was 4·30 per cent., as compared with 3·87 per cent. in the United Kingdom in 1894.* That they could—or, as a matter of business, would—build, either on their own standard or as light railways, the lines we are discussing, is not so certain; or, rather, this much is certain, that without the freely-given help of the State, these lines would not have been constructed at the very time when they were most wanted. Mr A. J. Balfour's Railway Act of 1889 was, in fact, the sufficient means not only of dealing with an immediate and pressing distress, but also of extending the lasting benefits of railway communication to poor and isolated districts.

The following is a list of these light railways:†—

Name.	Length in Miles.	Working Railway Company.
Achill Extension, . . .	8¼	Midland Great Western of Ireland.
Ballina and Killala, . .	8	Midland Great Western of Ireland.
Baltimore and Skibbereen, .	7¾	Cork, Bandon, and South Coast.
Bantry Bay Extension, .	1¾	Cork, Bandon, and South Coast.
Collooney and Claremorris, .	47	Waterford and Limerick.
Donegal and Killibegs, . .	18¾	Donegal.
Downpatrick, Killough, and Ardglass,	8	Belfast and County Down.
Galway and Clifden, . .	48¼	Midland Great Western of Ireland.
Headford and Kenmare, .	19¾	Great Southern and Western of Ireland.
Killorglin and Valentia, .	26¾	Great Southern and Western of Ireland.
Stranorlar and Glenties, .	24½	Donegal.
Westport and Mallaranny .	18	Midland Great Western of Ireland.

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* "Irish Railways and their Purchase by the State,"—*The Railway World*, Feb. 1896.

† *Railway Returns*, 1896.

The estimated cost of the Donegal line, on the 3 ft. gauge, the axle-load being restricted to eight tons and the maximum speed to twenty-five miles an hour, was as much as £6600 per mile. Of the total capital required by the company specially formed for its promotion, £115,600 was a free grant from the Treasury and 1000 guaranteed capital. If so light a line on a narrow gauge was to cost so much as £6600 per mile, we can easily conceive that the larger railway companies, which accepted Treasury grants covering less than this amount, for the construction of light railways on the standard gauge, to carry standard rolling-stock, were prepared to spend money out of their own pockets, in order to build what were practically standard railway extensions or branches of the existing main lines.

Finally, we have the Railways (Ireland) Act, 1896 [59 & 60 Vict. cap. 34], which brings Ireland more into agreement with the conditions prescribed for England and Scotland in the Light Railways Act, 1896 [59 & 60 Vict. cap. 48].

Thus, section 1 of the former corresponds with sections 4 and 5 of the latter, but differs from them inasmuch as it restricts State aid to an existing railway company, willing either to construct, work, and maintain the proposed railway, or to work and maintain it when constructed. On the certificate of the Lord-Lieutenant that the proposed railway is necessary for the development of a district too poor to induce the construction of the proposed railway without special assistance, the Treasury may agree to aid the existing railway company, willing to take up the proposed railway, by an advance, up to one-half of the cost of construction, provided that landowners, local authorities, and other persons locally interested, have done their fair part by free grant of land or otherwise. The advance may be a free grant or a loan at interest. The Board of Works may determine the surveys, plans, and estimates, if those submitted be not approved; and in the congested districts may undertake the construction if this existing railway company will not do so.

Section 4 corresponds with clause 6 of the English Act. It limits the total amount of advances to £500,000. The required money may be lent to the Treasury by the National Debt Commissioners.

Under section 3, certain provisions of the Tramways Acts—relating to baronial guarantees, tolls and rates of charge, deposits, interference of the country surveyor, etc.—are not to apply. On the other hand, under section 2, the Order in Council, confirming the agreement, may set forth the tolls and charges for passengers, animals, and things conveyed on the railway. At the same time, the railway is protected from unfair increase of local rates under clause 2 (c), which corresponds with section 5 (1) (c) of the English Act.

Powers of owners to grant land or advance money for a light railway are dealt with in section 5, which corresponds with section 19 of the English Act.

Entry on land is provided for under section 6.

The application of General Railway Acts is defined in section 8, which corresponds with section 12 of the English Act.

Under section 10, any Grand Jury may, under certain conditions, present money in aid of the railway.

Under section 13, this Railways (Ireland) Act, 1896, together with the Transfer of Railways (Ireland) Act, 1890—and the Tramways (Ireland) Acts as therein defined—and the Tramways (Ireland) Act, 1895, may be cited collectively as the Tramways (Ireland) Acts, 1860 to 1896.

CHAPTER X.

ROAD TRANSPORT AS AN ALTERNATIVE.

CONTENTS.—Traction engines mainly used for agricultural purposes—Legal and mechanical obstacles to their freer use—Not necessarily nuisances nor sources of danger—Locomotives on Highways Act, 1896—Motor-cars and light locomotives thus freed—Report of a select committee on traction engines, 1896—Recommendations of the committee—Possibilities of road locomotives for light and heavy work—Messrs John Fowler & Co.'s agricultural and road engines—Tyres for traction engines—Traction wagons.

Restrictions on use of Steam Locomotives on Roads.—At the end of the first chapter, it was observed that road transport—by road locomotives, traction engines and cars, auto-motors, etc.—might often supply the place of light railways.

"A very important subject for consideration also in connection with the Light Railways Act"—said Sir John Wolfe Barry* in his presidential address to the members of the Institution of Civil Engineers in 1896—"and, in itself, is the future of auto-motors as applied to the light traffic, whether of goods or passengers, to be accommodated by the proposed light railways; and no engineer can read the accounts of the results attained by auto-motors, or have seen the machines in operation, without recognising their promise for the future."

The difficulties opposed by the legislature to the use of steam-engines on roads† were such as practically to restrict their use to agricultural work—threshing and steam ploughing for example—and to the conveyance of merchandise and heavy material, which could not so readily be hauled by horses. This fact was borne out by evidence obtained in committee in 1896,‡ that the majority of traction engines escaped the payment of licence duty under the exemption granted to engines used solely for agricultural purposes.

Road locomotives were held to be nuisances at common law. It might take an owner three months to obtain from a Court of Quarter Sessions a licence to travel on the highway. In country districts the speed of a traction engine was limited to four miles an hour, and a man had to walk in front of it, at a distance of not less than twenty yards. The road authorities had almost absolute power to forbid the use of certain bridges by such engines (which we must acknowledge to be only reasonable), and damage done by them had to be made good, which would not have been required if horses had been used for draught. Moreover, urban authorities might embody in their local Acts clauses prohibiting the use of road locomotives in any street or in any road within their jurisdiction.

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* *Min. Proc. Inst. C.E.*, vol. cxxvii., 1897.

† M'Laren on "Steam on Common Roads," in *Min. Proc. Inst. C.E.*, vol. ciii., 1891.

‡ *Report from the Select Committee on Traction Engines on Roads*, 1st July 1896.

The mechanical difficulties, complained of by owners of road locomotives, included the heavy grades on the roads, the sharp corners, and the sinkage of bad roads.

The legal obstructions undoubtedly call for revision, and, to a considerable extent, for removal. The mechanical difficulties depend upon the claims of this particular description of road traffic to be regarded as ordinary traffic, for which the ratepayer must provide efficient roads. The question is whether traction engines can get outside the definition of extraordinary traffic furnished by Lord-Justice Bowen (in the case of Hill *v.* Thomas, 2 Q.B., p. 333):—

"Extraordinary traffic is really a carriage of articles over the road, at either one or more times, which is so exceptional in the quality or quantity of goods carried, or in the mode or time of user of the road, as substantially to increase the burden imposed by ordinary traffic on the road, and to cause damage and expenses thereby beyond what is common."

So long as they are covered by the term "extraordinary traffic," traction engines will be held responsible for excessive damage to roads and bridges, and the ordinary ratepayer will not be required to bring all the roads and bridges they wish to traverse up to their standard.

In the course of discussion at the Institution of Civil Engineers,* Sir Frederick Bramwell observed that the danger of setting fire to thatched buildings, ricks, or dried herbage by scattering fire from the ash-pan was unlikely if the speed did not exceed four miles an hour, and if the escape of fire up the funnel was guarded by a grating in the smoke-box just above the tube-level. Danger to life and property from scaring of horses was diminished by boxing in the machinery as in Hancock's carriages, and these also passed the steam into a silencing box which broke the blast. Traction engines fitted with air-condensers went without much noise from the blast.

In moving the second reading of the "Locomotives on Highways Bill," on the 30th June 1896, Mr Chaplin caused some amusement by expressing his belief that the light-road locomotive might become a dangerous rival of the light railway; that it would develop a big industry, tend to decrease railway fares, and prove to be of great advantage to agricultural interests in the transport of farm produce at a cheaper cost. They were largely used abroad, especially in France.

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* *Min. Proc. Inst. C.E.*, vol. ciii., 1891.

The "Locomotives on Highways Act, 1896" [59 & 60 Vict. cap. 36], describes a light locomotive as a vehicle propelled by mechanical power, itself being under three tons in weight unladen, and drawing not more than one other vehicle (such vehicle with its locomotive not to exceed in weight unladen four tons); it must be so constructed that it shall emit no smoke or visible vapour except from any temporary or accidental cause. A council of any county or county borough may prevent or restrict the use of such locomotives upon bridges which would be unsafe for them. A proper light must be exhibited by the locomotive at night. It must carry a bell to be used as a warning. Its speed must not exceed fourteen miles an hour, or any less speed prescribed by the Local Government Board; which also retains the power of making regulations regarding the construction and use of these locomotives, and of prohibiting or restricting their use in crowded streets or other dangerous places. An excise duty of two or (if the locomotive exceed two tons in weight) of three guineas, together with the license for the locomotive as a carriage or hackney carriage, is to be paid.

Motor-Cars relieved from some Restrictions.—On the 14th November 1896, motor-cars being no longer classed as traction engines, regulations, supplementary to the above Act, were issued by the Local Government Board, and some motor-cars made a trip from Northumberland Avenue, *viâ* Reigate, to Brighton. The "light locomotive" must be capable of being worked either forwards or backwards. There may be bosses or projections on pneumatic tyres, if they are used; otherwise, wheel tyres must be smooth, with a breadth varying from 4 to 2½ inches, according to the weight of the vehicle. Two independent brakes are required. Any drawn vehicle, too, must have a brake, or the brakes on the locomotive must be able to control it. The width of the locomotive must not exceed 6½ feet. If drawing another vehicle, the name and address of the owner must be conspicuously painted on it and its weight; moreover, the weight must be painted on every locomotive weighing unladen 1½ ton and upwards. These regulations fix the maximum speed at 12 miles an hour; if the weight be 1½ to 2 tons, the speed must not exceed 8 miles, and if the weight exceed 2 tons, the speed must not exceed 5 miles an hour; whatever the weight, if used to draw any vehicle, the speed must not exceed 6 miles an hour. Of course, the ordinary rules of the road and of street traffic apply.

The development of the motor-car or light road-locomotive, under the encouragement of the new Act, may take place in several directions. Steam, oil, and electricity are all in the field, but, for town work especially, the last appears to be the favourite.

Traction Engines.—On the 1st July 1896 was issued the *Report of a Select Committee on Traction Engines on Roads*, in which occurs the following paragraph regarding their employment and use:—

"In addition to the large number of locomotives used for ploughing and threshing and for steam-rolling, engines are employed in various districts for hauling such articles as corn, manure, lime, drainage pipes, timber, bricks, and other building materials; stone for the roads, boilers, and heavy pieces of machinery, and sometimes for lighter goods, such as flour and groceries from co-operative stores. They are thus of great benefit not only to the agriculturist, but also to the builder, the manufacturer, the distributor, and the consumer. They are largely used by some local authorities, and, to a considerable extent, by the War Department. *They are especially useful in districts where the railway communication is not good, and for the carriage of bulky articles which cannot conveniently be transhipped or conveyed by rail. In such cases it is often not only cheaper but quicker and less injurious to the articles carried to convey them all the way by road rather than to and from the railway stations.*"

Most of the traction engines escaped paying any license duty under the statutory exemption of engines used solely for agricultural purposes. They might be nuisances, but were scarcely a cause of appreciable danger. Horses were getting used to these steam carriages, and accidents seldom occurred. If properly lighted and attended to, there appeared to be little objection to these engines travelling by night on unlighted roads, judging from the experience of Kent and Aberdeen. Their use in crowded streets of large towns in the daytime seemed more objectionable, and they were accordingly prohibited in the middle of the day in London, Manchester, York, and other large towns; on the other hand, no such prohibition existed, nor was it apparently needed, in Leeds, Birmingham, Hull, Newcastle, and other important towns. The noise and vibration were naturally considered nuisances in residential towns, but serious damage was mainly limited to places where the houses were badly built, where the weights carried were excessive, and especially where, as in Aberdeen, the streets were paved with granite sets. The damage done to the metalled surface of ordinary roads was, however, considerable, while the owners were frequently not ratepayers within the county, and contributed little to the upkeep of the roads they used except the license duties. In spite of this, the engine-owners demanded that country, as well as town, roads should be maintained so efficiently as to bear the heaviest class of traffic likely to pass over them. That, of course, was most unreasonable, and the retention of "the extraordinary traffic clause" in the Act of 1878 (dealing with damage done to roads by extraordinary traffic or excessive weight) was strongly advised.

Under the Act of 1878 the country authorities (and quarter-session boroughs, with a population of 10,000 and upwards, and the Common Council of the City of London) were empowered to make bye-laws regarding the hours of travelling, regulating the use of locomotives upon any highway, and preventing such use upon bridges which might be unsafe. Out of 150 different bodies in England and Wales, 60 or 70 had exercised these powers, and the variety and complexity of their bye-laws were more than the users of locomotives could patiently bear: in one county a locomotive could not travel by night, entering another county it could not travel in the middle of the day. In regard to this, the committee very rightly observed :—" Restrictions on locomotion are always in themselves objectionable, and can only be justified by necessity or grave inconvenience. We think, therefore, that on principle the prohibitions on engines travelling should be made as light and as uniform as possible." The making of closing bye-laws could not be placed in the hands of a central authority like the Local Government Board ; local authorities could best appreciate the circumstances of each district, but they must use their power reasonably. The Committee, therefore, while recommending that local authorities should have no general powers of prohibiting the use of these engines within their county or county borough *as a whole*, considered that they should retain their present powers of making bye-laws to regulate their use upon any highway, and to prohibit their use in crowded streets or narrow roads or particular localities for special reasons.

Then, in regard to license duties, the owner of an engine domiciled on the borders of several counties, or travelling long distances, might have to pay the maximum duty of £10, without rebate or allowance, in more than one county. Here, again, an Imperial license duty seemed to be the obvious remedy, but the division of the revenue among the various local authorities concerned would be difficult, and local registration would be useless, as local control would be rendered impossible. A statutory duty of £10 was advised, payable to the county, in which the engine was chiefly used, and the engine should have a right of passing through any other county on payment of a registration fee of 2s. 6d. Additional duty, at the rate of £2 per additional ton, should be paid for engines weighing over 10 tons. Steam-rollers should be exempted from license duties, as are agricultural engines.

While expressing their opinion that the number of loaded trucks or wagons drawn by an engine should not exceed three (exclusive of a water-barrel), without the written consent of the surveyor, the Committee prepared to leave any restriction of the maximum length of the train to be prescribed by the local authorities in their bye-laws.

The speed had hitherto been restricted to four miles an hour in the open country and to two miles an hour when passing through towns. The Committee would increase the latter to three.

The desirability of unifying and consolidating the enactments relating to traction engines, and of re-enacting the law in a clear, consistent, and concise form was strongly urged at the conclusion of the Report ; and the Committee appended the following summary of the recommendations :—

I.—That the limit of speed be maintained at four miles an hour in the country, but be raised from two to three miles an hour in towns and villages.

II.—That engines be authorised to be used with driving wheels of any form of construction that may be from time to time approved by the Local Government Board.

III.—(*a*) That in addition to the two men in charge of an engine in motion, a third man should be required to accompany it, not necessarily in advance or on foot, but in such a manner as to be best able to assist horses passing either from the front or from the rear.

(*b*) That the fourth attendant be dispensed with in the case of trains consisting of three wagons or less.

(*c*) That in the case of two plough engines with their necessary gear closely following each other, only five men should be required in attendance.

(*d*) That one of the three attendants be required to remain with an engine while stationary on a highway, and having its fires alight.

(*e*) That at night every engine or train of wagons should carry a conspicuous red light in the rear, and that all lights should be fitted with shutters or screens.

IV.—(*a*) That a penalty not exceeding £10 be recoverable summarily for carrying weights on wagons in excess of those authorised by 24 & 25 Vict. cap. 70, s. 4, without the consent of the county or county borough surveyor.

(*b*) That a similar penalty be recoverable for drawing without such consent a number of loaded wagons exceeding three exclusive of a water-barrel.

V.—(*a*) That local authorities should have no general powers of prohibiting the use of engines for specified hours within their county or county borough as a whole.

(*b*) That local authorities should retain their present powers of making bye-laws to regulate the use of engines upon any highway, and should also have power by bye-law (subject to confirmation by the Local Government Board) to prohibit their use in crowded streets, or narrow roads, or in special localities for special reasons: And that in confirming such bye-laws the Local Government Board should have all proper regard to the necessities of through traffic.

VI.—That in all cases where a bridge is closed against traction-engine traffic by order of a local authority, an appeal should lie to an arbitrator appointed by the Local Government Board.

VII.—(*a*) That a uniform annual license duty of £10 be paid by the owner (or user) of each engine of not more than ten tons in weight, exclusive of water and coals, with an addition of £2 per ton for every extra ton.

(*b*) That a license may be transferred from one engine to another belonging to the same owner with the consent of the licensing authority.

(*c*) That the county or county borough council receiving the duty be required to provide a license plate with the name of the county or borough, the number and date to be fixed to the engine, and not to be removed during the year without the consent of the licensing authority.

(*d*) That every engine so licensed be authorised to pass through any other county or county borough on payment of an annual registration duty of 2s. 6d. for each county or county borough.

(*e*) That steam-rollers (as well as agricultural engines) be exempt from license duty, but that all engines be required to be registered at a nominal fee with the county authority, and to carry a registered number.

(*f*) That the expression "agricultural engine" should include any engine used solely for threshing, ploughing, or other agricultural purpose, and any engine the property of one or more occupiers or owners of agricultural land, employed solely for the purposes of their farms or estates, and not let out for hire.

(*g*) That similar license duties be levied in Scotland and Ireland.

VIII.—That the extraordinary traffic clause [41 & 42 Vict. cap. 77, s. 23] should be amended as follows:—

(*a*) The time for the recovery of expenses to be limited to a period of twelve months from the damage complained of, or (in case of a particular contract or building job) of six months from the termination of the work.

(*b*) The expenses to be recoverable from any person by whose order "or for whose benefit" the work is done.

(*c*) The expenses not to be recovered before justices, but in the County Court, or, in case of large amounts, in the High Court.

In Scotland an appeal should be allowed from the Sheriff's Court to the Court of Session, in order to secure uniformity in the decisions.

The Clause should be extended to Ireland.

IX.—That the amount of the penalties for various offences should be revised, and that the law as amended should be consolidated in one Statute for the United Kingdom.*

Traction engines already do a great deal of the kind of work that light railways propose to do; and their emancipation from the

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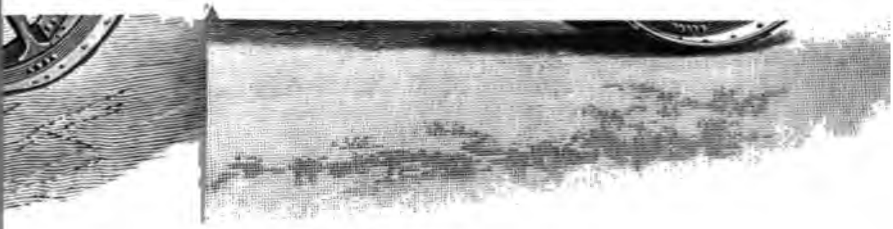
* The Locomotives Act, 1898 (61 & 62 Vict. c. 29), has since been passed. It is dated 2nd August 1898.



Compound Road Locomotive

anomalies and penalties of the old Acts and local bye-laws would give them a fair field. There is little doubt that *steam* traction will continue to hold that field, as in the past. Of the use of such engines we are reminded in the Report of the Select Committee. Heavy parts of machinery, boilers, trees, blocks of stone, etc., are more conveniently conveyed by them over moderate distances very often, than if such bulky articles were carried *to* the railway, *by* the railway, and *from* the railway to their destination. The cost of working has been estimated* to be about 2d. per ton per mile.

Of these engines Messrs John Fowler & Co. (Leeds) manufacture two types. The first (Plate I. fig. 1) is designed for agricultural purposes and general work about a farm or estate, such as occasional haulage, driving any belt-driven machinery, pumps, saws, pile-driving hoists, threshing machines, chaff-cutting machines, dynamos, etc. The second type, generally known as road locomotives (Plate I. fig. 2), is specially designed for continuous heavy haulage and long journeys on roads, the working parts of the engine being screened to hide them as far as possible from horses.

The gearing in engines of the second type is of extra strength, the bearings and journals are of larger size, and the tank and bunker capacity are increased to carry a greater quantity of water and fuel. The driving wheels are of large diameter, giving greater adhesion on the roads. This type of engine has been made with three road speeds —approximately 2, 4, and 8 miles an hour. A spring-mounted compound road locomotive of 10 nominal horse-power has been known to run a mile in 5¼ minutes when time was precious. The compound principle and spring mounting are a *sine quâ non* of this type of engine. The rear axle spring arrangement is based on powerful twin springs, the parts being so arranged that when either driving-wheel comes in contact with any obstacle on the road the other wheel takes its share of the shock, the movement being compensated by transverse levers. The third motion shaft and rear axle bearings are connected, and move simultaneously—in response to the elastic movement of the spring between the horn-blocks—thus giving similar freedom of motion to that which we appreciate in the railway locomotive. At the same time, these engines can be used for belt-driving or any purpose to which the agricultural engine is otherwise applied.

Details and prices are quoted in the following list. To the prices here given must be added such extras as injector (if required in the case of agricultural engines), spark arrester, enlarged firebox, awning, packing for shipment, and duplicate wearing parts. In the prices are included a winding drum and 50 yards of wire rope, a steam water-lifter, and 26 feet of suction hose:—

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* Maclaren on "Steam on Common Roads," *Min. Proc. Inst. C.E.*, ciii., 1891.

		Single Cylinder.				Compound Cylinder.			
	Class.	D	A	B	C	D	A	B	C
Agricultural Traction Engines.	Actual horse-power, .	14	22	30	38	15	24	33	42
	Diam. of ordinary wheels,	5′ 1½″	5′ 6″	6′ 0″	6′ 6″	5′ 1½″	5′ 6″	6′ 0″	6′ 6″
	Width of ,, ,,	1′ 2″	1′ 4″	1′ 4″	1′ 6″	1′ 2″	1′ 4″	1′ 4″	1′ 6″
	Diam. of fly-wheel, .	4′ 0″	4′ 6″	5′ 0″	5′ 0″	4′ 0″	4′ 6″	5′ 0″	5′ 0″
	Width of ,, .	5 in.	6 in.	6 in.	7 in.	5 in.	6 in.	6 in.	7 in.
	Revolutions per minute, .	180	150	150	150	180	150	150	150
	Price, . . .	£360	£410	£465	£530	£415	£465	£540	£630
Special Road Locomotives.	Actual horse-power, .		22	30			24	33	
	Diam. of ordinary wheels,		6′ 6″	7′ 0″			6′ 6″	7′ 0″	
	Width of ,, ,,		1′ 4″	1′ 6″			1′ 4″	1′ 6″	
	Diam. of fly-wheel, .		4′ 6″	4′ 6″			4′ 6″	4′ 6″	
	Width of ,, .		6 in.	6 in.			6 in.	6 in.	
	Revolutions per minute, .		150	150			150	150	
	Price, . . .		£490	£560			£550	£635	

Both types of engines are constructed either on the single cylinder or compound principle. There is no doubt that the compound locomotive is coming into more general use. The boiler can be reduced in size; there is a saving in fuel and water; the noise from the exhaust in the chimney is suppressed; and, for emergent purposes, high-pressure steam may be admitted into the low-pressure cylinder.

These engines are provided with multitubular boilers, ventilated fire-hole doors, and ash-pans with adjustable dampers, and may fairly claim to be considered as smoke-consuming. They are fitted with steel-plate, pressed ash-pans to carry water and to prevent the dropping of fire. With the compound engine there is practically no noise from steam discharge beyond a short quick puff at starting.

Most of the weight, of course, is thrown on the rear or driving wheels. Thus, Messrs John Fowler & Co.'s class A4 single cylinder agricultural traction engine (the nominal weight of which is about 8½ tons or when full 9½ tons) places roughly 7½ tons of this upon the "drivers" and only 2 tons upon the steering or front wheels. Their class A4 compound road locomotive (the nominal weight of which is about 10 tons or when full 11¼ tons) places roughly 9 tons of this upon the "drivers" and only 2¼ tons on the "steerers." It will be seen, therefore, that the engines are so balanced on their wheels as to give as great adhesive power as possible on the "drivers."

Smooth-soled wheels are of little use for purposes of traction on any but very level ground. In the *Report of the Select Committee on Traction Engines* reference is made to the damage done to road paving by the diagonal cross-bars with which the driving-wheels might otherwise be shod. The Boulton blocks, although not authorised, were tacitly permitted in many districts. They consist of wood blocks, bedded upon pliable pads, and loosely held in their sockets by spring bolts, so that from three to five of these pads come in contact with the ground at the same time, distributing the pressure and diminishing the noise. But, although they were harmless to pavements if the blocks were in good repair, they might actually cause more damage than the diagonal cross-bars if the blocks became worn down. It seemed more necessary, therefore, to direct attention to the *condition* than to the *kind* of tyre adopted.

Traction wagons may be mounted on springs or constructed with solid axle-beds as required, and Messrs John Fowler & Co. build them to suit any particular description of transport. The fore-carriage—like the steering axle of the engine—is fitted with a turntable. The wagon is attached, by means of a triangular coupling-bar and chain, to a jaw on the traction engine. The coupling-bar has a double-acting, spring drawing-bar arrangement, which comes into action in starting as well as in steering.

There are, of course, many types of traction wagons (Plate I. fig. 3), and some have a turntable fore-carriage at each end, which is convenient where the space for loading or discharging is limited. Among others, the writer noticed a traction wagon weighing 3 tons and carrying a load of 8 tons. The total weight was distributed on the wheels so as to relieve "steerers" to some extent, 5 tons being carried on the leading axle, which was fitted with a pivoting or turning-circle, and 6 tons on the rigid or rear axle. For the discharge of broken road-metal, bricks, lime, etc., special traction wagons are built, the bodies of which, by an arrangement of rack, roller, and lever, may be moved to either side and tilted by gravity.

CHAPTER XI.

THE LIGHT RAILWAYS ACT, 1896.

CONTENTS.—First use of term "light railway" in an Act of Parliament—Failure of Acts of 1864–68 to facilitate construction of light railways—Difficulties increased by Act of 1889—The Light Railways Act, 1896—Light railways not defined in the Act—Their differentiation from tramways—Light Railway Commissioners—Rules for making application for an order authorising a light railway—Powers of Local Authorities—Conditions under which State aid may be given—Consideration of application by Commissioners—Submission of order to Board of Trade—Consideration of order by Board of Trade—Order confirmed by Board of Trade to have effect as if an Act—Provisions which may be made by the order—Clauses Acts and enactments relating to safety, etc., not to apply unless incorporated in the order—Application of general Railway Acts—Procedure for taking of land simplified—Local inquiries and reports to Parliament by Board of Trade—Expenses of Local Authorities—Working of ordinary railway as light railway—Conveyance of private or Crown lands—Application of Telegraph Act, 1878—Scotland included in the Act—Ireland otherwise provided for.

THE LIGHT RAILWAYS ACT, 1896.

Summary of earlier Legislation.—The first actual use in an Act of Parliament of the term "light railway" occurs in section 27 of the Regulation of Railways Act, 1868 [31 & 32 Vict. cap. 119], under which "the Board of Trade may by license authorise a company applying for it to construct and work, or to work as a light railway, the whole or any part of a railway which the company has power to construct or work." Section 28 prescribes that, on such lines, the axle-load shall in no case exceed 8 tons, nor the rate of speed of trains exceed 25 miles an hour; but, subject to these maxima, a light railway may be constructed and worked under such conditions and regulations as the Board of Trade may from time to time impose or make. The limitations of the axle-load prevented the circulation of main-line stock, and assisted to render the Act inoperative.

There is an earlier and equally abortive Act, the Railways Construction Facilities Act, 1864 [27 & 28 Vict. cap. 121], designed "to facilitate, in certain cases, the obtaining of Powers for the Construction of Railways"—such as the making of branches, new works in connection with existing railways, etc.—*where landowners and others beneficially interested consent to the making of the same.*

Under this Act, promoters may enter into provisional contracts for land required, and their subsequent procedure is thus prescribed :—

"(1) They shall apply to the Board of Trade for a certificate under this Act :

"(2) They shall deposit maps, plans, sections, and books of reference, and an estimate of the expense of the construction of the railway, and lodge a draft of the certificate as proposed by them, according to the general rules of this Act:

"(3) They shall publish notice of the application according to such general rules."

The Board of Trade may then, after considering all representations and objections, settle a certificate authorising the making of the railway. This draft certificate is to be laid before the Houses of Parliament, either of which may stop it, which involves the upsetting of all contracts for land. Otherwise, being approved, the Board of Trade may issue and publish in the *London Gazette* the certificate, which is thenceforward to have the same force as would a special Act.

With the certificate are to be incorporated the Lands Clauses Acts and the Railways Clauses Acts, *except those provisions which give compulsory powers, etc.*

The Board of Trade has power to incorporate a company by the certificate, in which case the Companies Clauses Acts are to be included in the certificate.

With a view to ensuring the completion of the railway, the promoters are obliged to deposit 8 per cent. on the estimate in the Court of Chancery.

The maximum tolls and charges are specified in the schedule, *e.g.* :—Third-class passengers, 1¼d. per person per mile; minerals, etc., in class 7 goods, 1½d. per ton per mile. But the Board of Trade has power to vary these, and they do not include a reasonable charge for loading, covering, and unloading at stations (terminal charges), and for delivery, collection, etc.

It may be asked to what extent the development of light railways was encouraged by such facilities as were afforded by these two Acts; and, after they have been in force for nearly thirty years, the answer is given in the Report of a Committee presented (in January 1895) to the Right Honourable James Bryce, M.P., Chairman of a Conference on Light Railways:—

"Practically no light railways have been constructed under the general Acts of 1864 and 1868, owing in part, it is alleged, to the consent of all landowners and other parties beneficially interested, and the absence of opposition from any railway or canal company, being necessary before the Act can be made use of.

"The mileage of such lines constructed under special Acts has also been inconsiderable.

"This lack of progress in rural districts has also been in great measure due to the want of latitude left to the Board of Trade by law, and, in other cases, to the conditions which the Board considered it their duty to impose for the public safety."

The more power was given to the Board of Trade to call upon the railways to provide safety appliances, the less able was that Department to relax their demands in favour of any particular railway, however poor it might be, and however extravagant and unnecessary was such an equipment for a line whose traffic was sufficiently served by few and slow trains. The climax was reached in 1889. The Regulation of Railways Act, 1889 [52 & 53 Vict. cap. 57], enacts that "the Board of Trade *may* from time to time *order* a railway company" to adopt the block system on passenger lines, to interlock their points and signals, and to use on all their trains continuous brakes which must be instantaneous in action, applicable by the driver and the guards, self-applying in the event of failure in any of the brake-parts, etc. The word "may" has no suggestion of compulsion to the casual reader, and the following qualification—"In making any order under this section the Board of Trade shall have regard to the nature and extent of the traffic on the railway, and shall, before making any such order, hear any company," etc.—seems, at first sight, to leave it open to the Board of Trade not to enforce such requirements where they are obviously unreasonable. Nevertheless, the writer in 1891 and 1892—while on special duty under the orders of the Secretary of State for India—found a poor line like the Cambrian (whose gross traffic receipts at the present moment may be about £21 per mile per week) as busily employed in providing safety appliances as the London and North-Western Railway (whose gross receipts are very nearly £119 per mile per week). Indeed, the Cambrian had much more to do, comparatively speaking, for the London and North-Western line was practically fully equipped already, in compliance with an enormous movement of traffic which rendered the most perfect appliances for safe working absolutely necessary.

The fact is an Act like this, which empowered the Board of Trade not merely to suggest but to *order* certain provisions to be made for the public safety, so quickened their sense of responsibility that they saw no way of modifying their demands to suit the conditions of the lighter lines. What was really wanted was not a uniformly high standard of construction and working, but a larger freedom in reducing their demands to the reasonable and practicable requirements of each case.

Analysis of the Light Railways Act, 1896.—We shall now examine the Light Railways Act, 1896 [59 & 60 Vict. cap. 48],* and see what facilities it affords for the development of light railways in Great Britain.

While this Act applies to light railways, it does not define them. The actual determination of the claims of a line under consideration to be called a light railway lies with the Board of Trade (section 9). The following amendment was proposed, in the course of the proceedings of the Standing Committee on Trade on the Light Railways Bill, but was withdrawn :—

"A railway shall be deemed to be a light railway if the cost of construction thereof, exclusive of land, legal charges, and rolling-stock, shall not exceed £3000 a mile, and if the speed shall not exceed, inclusive of stoppages, 16 miles an hour outside of towns and villages and 6 miles an hour inside of towns and villages, and if the weight of the locomotives, coaches, and wagons shall not exceed 8 tons per axle."

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* Appendix VIII.

We may safely say that a light railway is one which, on account of the nature and amount of the probable traffic, must, if it is to be constructed at all, be of a lighter character, more cheaply built, more economically equipped, less hampered by safety regulations, and more simply worked than a standard railway. The distinction between one and the other will be more or less marked according to circumstances, but it would be impracticable to make this distinction depend separately upon weight of rail, gauge of line, maximum axle-load, maximum speed, or any of the many details which make up the *potential* of a railway.

On the other hand, the distinction between a light railway and a tramway cannot be absolutely drawn, and the question will constantly arise whether a scheme should be dealt with under the Tramways Act or under the Light Railways Act. The average Englishman's notion of a tramway is practically confined to street tramways, where the head of the rail is grooved to take the flange of the wheel, not plain, as on railways, to support the tread of the wheel, while the tram-rail is sunk so that the head is flush with the surface of the road, and the arrangement of the permanent-way is such as enables block-paving or metalling to be laid down between and outside the rails. This is certainly the sort of tramway contemplated in the Tramways Act [33 & 34 Vict. cap. 78] of 1870. Section 25 of that Act prescribes that the uppermost surface of the rail shall be on a level with the surface of the road; section 28 deals with repairs of the metalled or paved surface of the road where the tramway is laid; and the provisions in all the construction sections clearly indicate such restricted conception of the term. In America and on the Continent they are much more familiar with road tramways than we are, and, when these are laid on one side of the road, they do not generally present the same physical features as our street tramways. Thus, in France, a tramway is a line which runs for more than two-thirds of its whole length on or along the sides of the public roads, and one which does so for a less distance is a railway. So, too, in England, we have the Wisbech and Upwell tramway, constructed by the Great Eastern Railway, running along the side of a public road, but retaining nearly all the physical features of a railway; the reason for applying the term tramway to this line would seem to be legal rather than technical, for, there being no Light Railways Act, it had to be constructed under the Tramways Act. The Wisbech and Upwell trains, however, will take up and set down passengers by the wayside, which all tramways are supposed to do, whereas most railways do so at definite stopping-places or stations only. On the other hand, tramways are not bound to carry goods, while it is the business of a railway to deal with such traffic as well as with passengers. One of the reasons of the inability of the Tramways Act to meet the want which the Light Railways Act is intended to supply, was that it proved useless for the carriage of goods. It was only with the assistance of the railway companies, or when they actually belonged to a railway company (as in the case of the Wisbech and Upwell Tramway), that tramways could successfully deal with goods traffic. In such cases, if the rail and gauge would admit of the passage of ordinary goods wagons over the tramway, the latter could be linked up to the main line, and the railway could provide space and arrangements for loading, unloading, transhipment, collection, delivery, clerkage, and other services connected with goods traffic. Otherwise, the Tramways Act gave the small lines no power to obtain these facilities. And there were difficulties with the local authorities. The latter found that, even if the Tramway Company maintained the portion of the road covered by their track and for a distance of 18 inches beyond their rails, the great bulk of ordinary street traffic was driven to that portion of the road which the local authorities had to repair, and the cost of its repair might be doubled. Finally, the local authorities, in some cases, made hard bargains with the companies, inserting and enforcing clauses giving them right of pre-emption on such terms as greatly conduced to check the development of tramways under the Act of 1870. The Light Railways Act of 1896 will, it is hoped, afford no opportunity for such discouragement of useful schemes, but the Tramways Act will still remain for the benefit of lines constructed under the Act, as well as for those proposed lines which are entitled to be classed as tramways. Before leaving the subject of tramways it may be mentioned (as in Chapter I.) that tramroads, as distinguished from tramways, are only dealt with in a Standing Order of the Houses of Parliament.

Under section 1 of the Light Railways Act is "established a commission, consisting of three commissioners, to be styled the Light Railway Commissioners, and to be appointed by the President of the Board of Trade." They are the Earl of Jersey, G.C.M.G., Chairman; Mr G. A. Fitzgerald, Barrister-at-Law; and Colonel G. F. O. Boughey, R.E., C.S.I., who was for many years manager of two of the great Indian State Railways. Their duty is to "carry the Act into effect and to offer every facility for considering and maturing proposals to construct light railways," in other words not to block a scheme by applying every condition that may relieve an official department of responsibility, but to give it all reasonable encouragement and assistance. The Commissioners have liberally accepted and acted upon this principle; and in time, no doubt, the Board of Trade will find less difficulty in adapting their requirements to the new class of railway.

Under section 2, an application—preceded by compliance with section 7 (1) and (2)—for an order authorising a light railway may be made to these commissioners by the council of any county, borough, or district, through any part of which the proposed railway is to pass, by any individual, corporation, or company, or by any of these jointly. Parish councils are not mentioned.

The rules[*] made by the Board of Trade—"to regulate the procedure before the Light Railway Commissioners, where a scheme for a light railway has been matured, and it is intended to make a formal application for an order"—are quoted in Appendix IX.

Section 3 gives to the county, borough, or district council, if authorised by an order, power to undertake, or to contract for, the construction or working of the light railway; to advance to a light railway company—either as a loan, or as part of its share capital, or partly in one way and partly in the other—any amount authorised by the order; or to join any other council, person, or body in doing any of these things, or any such other act incidental to them as may be authorised by the order. The council's application must, however, be supported[†] by a special resolution of the council, passed after a month's previous notice, and by two-thirds of the members present and voting. Moreover, if the light railway lie wholly or partly outside their area the council can take no action in the way of construction, working, contract, or advance, except *jointly* with the council of the outside area, unless they satisfy the Board of Trade that such action is expedient in the interests of their own area, and, even then, their expenditure will be limited by the order to an amount proportionate to the benefit that may accrue to their area.

Thus, a council may keep the whole of the undertaking in its own hands, and be altogether independent of contractors. Or they may construct the line by contract, and they may lease the working, in which case the formulæ tried in France and Belgium deserve attention.

If a council have made, or agreed to make, an advance to a light railway company, the Treasury may, under section 4, lend as much as one-quarter of the total amount required, but not more than the amount for the time being advanced by the council; provided that one-half of the total amount is subscribed as "share capital," and of that share capital at least one-half has been paid up by persons other than local authorities. Such a Treasury loan is to bear interest at not less than 3⅛ per cent. per annum. We have here the first mention of that State aid which has all along been readily accepted in Ireland, but which has been hitherto unknown in England and Scotland.

Section 5 provides for *special* assistance from the State in exceptional circumstances. Where the Treasury is satisfied, by a certificate from the Board of Agriculture or the Board of Trade, that a light railway is necessary in the interests of agricultural, fishing, or other definite industry, and the line would not be made without such assistance, the Treasury may aid the railway out of public money by a special advance, either as a free grant or as a loan, not necessarily bound by the terms of loan laid down in the previous section; provided that those locally interested have properly supported and assisted the scheme; provided also that an existing railway company will undertake to construct and work the railway; but the special advance is not to exceed one-half of the total cost of construction; and the railway may be guarded, in any parish, from an assessment of local rates higher than that imposed when the railway land was acquired. We, in India, know how much railways may have to pay out of their own pockets on account of land, previously worthless, which has simply acquired its present value from the adjacent railway.

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[*] *Statutory Rules and Orders*, 1896, No. 787.

[†] First Schedule to the Act.

Section 6 limits the total amount advanced by the Treasury at any one time to £1,000,000, of which not more than £250,000 may consist of special advances. The Treasury may borrow from the National Debt Commissioners money required for the purpose of advances.

Section 7 deals with the consideration of the application by the Light Railway Commissioners.

They must satisfy themselves that the local authorities, including the road authorities, and owners and occupiers of the lands it is proposed to take up, have been duly consulted; and that public notice of the application has been given. The Commissioners must also obtain by local inquiry, and by such other means as they think necessary, all material and useful information for dealing with the application.

The applicants must satisfy the Commissioners that they have published advertisements in a local newspaper as prescribed in section 7 (2) (*a*); that they have served notices on, and obtained the agreement or objections of, every reputed owner, lessee, and occupier to the taking of his land. The publication of an advertisement, two weeks running, in a local newspaper, of the land required, naming a place where a plan of the proposed works and required land may be seen, etc., disposes of an expensive detail. Hitherto railway promoters have had to pay for long advertisements in local and other newspapers, including an abstract of all the information which might just as well be obtained by the purchase of a cheap copy of the bill. Rules * 1, 2, 21, 27, 28, and 29 lay down precise instructions in regard to these notices and advertisements; rules 5 to 20 deal with the plans, book of reference, and sections required.

The Commissioners must hear and consider all objections to the application, whether made formally or informally.

They may then settle the draft order submitted by the applicants, and insert further provisions for the public safety, particulars of the land required, conditions in regard to construction and working, etc., if such are required.

This order would be provisional only, not having effect until confirmed by the Board of Trade, as provided under sections 8, 9, and 10 of this Act.

If the Commissioners refuse an application, the applicants, if the council of any county, borough, or district, may appeal to the Board of Trade, who may remit the application to the Commissioners for further consideration.

The Commissioners must submit their order—with particulars, plans, statement of objections, report thereon, etc.—to the Board of Trade, as prescribed in section 8, and the Board of Trade must give public notice of the order and receive objections.

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* Appendix IX., *Statutory Rules and Orders*, 1896.

In accordance with section 9, the Board of Trade must consider the order "with special reference to (*a*) the expediency of requiring the proposals to be submitted to Parliament, and (*b*) the safety of the public, and (*c*) any objection lodged with them."

They might be induced to take the first course on account of the magnitude of the undertaking, or its affecting the interests of an existing railway company. We must not have light railways competing, on indulgent conditions, with standard railways.

Under section 10, an order confirmed—with or without modifications—by the Board of Trade shall have effect as if it were an Act of Parliament.

Under section 11, an order may contain provisions for all or any of the following purposes:—

"(*a*) The incorporation, subject to such exceptions and variations as may be mentioned in the order, of all or any of the Clauses Acts." What these are we shall inquire presently. Where it appears that variations of the Lands Clauses Acts are required by the special circumstances of the case, the Board of Trade "must make a *special report to Parliament* on the subject"; and nothing is to "authorise any variation of the provisions of the Lands Clauses Acts with respect to the purchase and taking of land *otherwise* than by agreement."

(*b*) The application—if and only so far as necessary—of any of the *safety* enactments mentioned in the second schedule. These will be briefly referred to later on; it need only be observed here that this gives the Board of Trade freedom to narrow their requirements to what is really reasonable in each case.

(*c*) Giving the necessary powers for constructing and working the railway.

(*d*) Giving any railway company any power required for carrying the order into effect.

(*e*) The constitution as a body corporate of a company to carry out the order.

(*f*) The representation, on the management of the railway, of any council advancing money for the undertaking.

(*g*) Authorising, limiting, and regulating the advance or borrowing of money for the railway by a council.

(*h*) The division of profits where a council advances money as share capital.

(*i*) Proper audit of accounts, of the managing body (unless a local authority), and the time within which the railway must be constructed.

(*j*) Fixing the maximum rates and charges for traffic.

(*k*) Requiring the company, if a new one, to make a deposit. There would never have been any objection to making a deposit, *after* obtaining a special Act and before commencing construction, and that is what this clause amounts to.

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(*l*) Empowering any local authority to acquire the railway.

(*m*) Any other matters ancillary to the objects of the order.

Before advancing further in our summary of the sections of the Light Railway Act, it will be advisable to make a brief reference to the Clauses Acts, as defined by this Act.

According to section 28 they are :—

The Lands Clauses Acts ;
The Railways Clauses Consolidation Act, 1845 ;
The Railways Clauses Act, 1863 ; and
The Companies Clauses Acts, 1845 to 1849.

The Lands Clauses Act, 1845 [8 & 9 Vict. cap. 18], consolidates "in one Act certain provisions, usually inserted in Acts authorising the taking of lands for undertakings of a public nature."

It deals with the purchase of lands by agreement (sect. 6–15) *or otherwise* (sect. 16–80). The latter case is especially important, for while—under section 11 (*a*) of the Light Railways Act—all or any of the Clauses Acts may be incorporated in an order, subject to exceptions and variations, there must be no variations whatever of the provisions of the Lands Clauses Acts with respect to the purchase and taking of land *otherwise than by agreement*, and sections 16 to 80 of the Act of 1845 must remain unaltered, except that section 13 (1) of the Light Railways Act provides for a single arbitrator.

Those sections demand the subscription of capital before compulsory powers are put in force ; require notices to be duly served ; provide for the settlement of disputes as to compensation, if the amount claimed do not exceed £50, by two justices, and, if it exceed £50, by arbitration or jury, at the option of the claimant ; require, where more than one arbitrator is appointed, the nomination by them of an ultimate umpire ; empower the Board of Trade to nominate an umpire, if the arbitrators neglect to do so ; place the determination of the matter in the hands of the umpire, if the arbitrators fail to make their award within twenty-one days ; decide the incidence of costs of arbitration, according to the amount of the award ; enable, otherwise, the promoters to summon a jury for settling any case of disputed compensation, the warrant they issue being addressed to the Sheriff, who shall summon a jury of twenty-four indifferent persons, from whom a jury of twelve shall be impannelled, the Sheriff presiding at the inquiry ; decide the incidence of costs of such inquiry before a jury ; provide for the determination of compensation to absent parties by a surveyor appointed by two justices, but such valuation is liable to be submitted to arbitration by the absent party if he be dissatisfied ; direct that, in estimating purchase-money or compensation, regard shall be had by the justices, arbitrators, or surveyors not only to the actual value of the land but also to the damage, if any, due to severing the lands taken from other lands of the owner, etc. ; direct, if lands have been taken or injuriously affected, and the promoters have not satisfied any interested party, that his claim for compensation is to be settled by arbitration or jury at his option; and provide for the deposit, treatment, and ultimate application of purchase-money or compensation payable to parties having a partial or qualified interest in such lands, or prevented from treating, or not making title; thus, if the money payable to a party under disability amount to £200 or more, it must first be paid into the bank in the name of the Accountant-General of the Court of Chancery, and if it amount to between £20 and £200 to trustees, and if it be £20 or less to parties. It is impossible to do more here than indicate roughly the scope of these sections (16–80), which, quoted *in extenso*, would occupy thirty times as much space as this paragraph; but, since these sections must be applied, without variation, to the purchase of land otherwise than by agreement, it seemed necessary to refer to them more precisely than to the rest of the Act of 1845.

We may now allude still more briefly to the remainder of the Lands Clauses Act, 1845. The conveyance of lands is dealt with (sect. 81–83). Entry on lands (sect. 84–92) must not, without consent, be effected by the promoters, except for surveying, taking levels, or setting out the line, until the purchase-money has been paid or deposited. Owners of intersected lands (sect. 93–94) may require the promoters to purchase the same. Special procedures are to be followed in the conveyance of copyhold lands to the promoters (sect. 95–98), in satisfaction of the rights of commoners (sect. 99–107), in the purchase or redemption of interest in the case of lands in mortgage (sect. 108–114), in respect to lands charged with rent-service (sect. 115–118), and in the case of lands subject to leases (sect. 119–122). Other matters dealt with are the limit of time for compulsory purchase (sect. 123), interests omitted to be purchased (sect. 127–132), land tax and poor's rate (sect. 133), service of notices upon company (sect. 134), tender of amends (sect. 135), recovery of penalties (sect. 136–149), access to Special Act (sect. 150–151), non-extension of the provisions of the Act to Scotland (sect. 152).

Several amendments, extensions, and repeals of portions of the Act have since been made. For example, the Railway Companies Act, 1867, modifies the section under which entry may be made before the amount of purchase-money has been settled, and provides that, in questioning disputed compensation, the incidence of costs of arbitration may be determined by one of the Masters of the Court of Queen's Bench, while the Regulation of Railways Act, 1868, provides that either the company or the claiming party may apply to a common law judge at Westminster* to try the question in one of the superior courts.

The Railways Clauses Consolidation Act, 1845 [8 & 9 Vict. cap. 20], consolidates "in one Act certain provisions usually inserted in Acts authorising the making of railways, so that any of the clauses of this Act may, in so far as they apply to the matter dealt with, be readily incorporated in the special Act authorising the construction of any particular railway." It enacts that the power given by a special Act to construct a railway and to take lands, shall be subject to the provisions and restrictions of this Act and of the Lands Clauses Consolidation Act, the scope of which has been roughly sketched above. Work is not to be proceeded with until plans of all alterations authorised by Parliament have been duly deposited with the clerks of the peace, parish clerks, postmasters, etc. Deviations from levels, alignment, etc., are definitely limited and liable to objections from neighbouring owners. The interference of the railway with gas, water, and drainage is guarded. Temporary occupation of roads and lands is provided for under various restrictions, and even the liability to compulsorily purchase them. A railway must not cross public roads on a level unless otherwise provided by its special Act, in which case the company must erect gates and keep them closed across the roads, unless the Board of Trade orders them to be closed across the railway, and speed over level-crossings adjoining stations is limited to four miles an hour. Standard dimensions are laid down for bridges, and provisions are made for guarding the road-approaches, the limiting gradients of which are specified. The company may be required to construct screens for roads where horses might be frightened by the trains. Gate-bridges, fences, drains, and other works for the accommodation of owners and occupiers of adjoining lands must be made by the company. Owners may make private branch railways communicating with the railway under certain restrictions and conditions. The company is debarred from mining unless they purchase the right to do so. The company is authorised to carry passengers and goods, and "to make such reasonable charges in respect thereof as they may from time to time determine upon, not exceeding the tolls by the special Act authorised to be taken by them." The company is not to be liable to a greater extent than common carriers. The company may alter or vary tolls, but "such power of varying should not be used for the purpose of prejudicing or favouring particular parties," and such tolls are to be "charged equally to all persons" under like circumstances. The company is authorised to make and alter bye-laws regulating speed, times of arrival, the loading and unloading, and the receipt and delivery of goods, etc. It is enacted that engines are to consume their own smoke, and—as the use of the railway by rolling-stock belonging to other owners was then contemplated and customary—the engines and carriages must be such as comply with the company's regulations.

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* Now, of course, at the New Law Courts in the Strand.

The Railways Clauses Act, 1863 [26 & 27 Vict. cap. 92], also consolidates in one Act certain provisions frequently inserted in Acts relating to railways. Part I. relates to the construction of a railway. Deviations within the limits and the alteration of engineering works may be authorised by the Board of Trade. Trains must not be shunted at a level-crossing; the company must erect a lodge at the crossing, or the Board of Trade may, at any time, require a bridge in place of the crossing. The conditions for satisfying another railway, with which a junction is to be effected under the special Act, are laid down, and the interests of navigation on tidal waters are protected. Part II. deals with the extension of the time limiting the power of the compulsory purchase of lands. Under Part III. the various matters of maintenance, use, working, rates, fares, etc., which arise in working agreements between two or more companies, are restricted, the sanction of shareholders is required, and the approval of the Board of Trade (but by a later Act the powers of the Board of Trade are transferred to the Railway Commissioners). Part IV. determines the conditions under which a company may build, or buy, or hire, and use steam vessels. Finally, Part V. deals with amalgamation as between two companies.

The Companies Clauses Consolidation Act, 1845 [8 & 9 Vict. cap. 16], consolidates "in one Act certain provisions usually inserted in Acts with respect to the constitution of companies incorporated for carrying on undertakings of a public nature." It need only be observed here that this Act provides in detail for the distribution of the capital into shares, the transfer of shares, the payment of calls, the borrowing of money on mortgage or bond, the conversion of borrowed money into capital, the consolidation of shares into stock, the application of the capital, firstly, to payment of costs and expenses incurred in obtaining the special Act, and, secondly, to carrying the purposes of the company into execution, general meetings (both ordinary half-yearly and extraordinary) and the title of shareholders to vote, according to scale, either personally or by proxy, the appointment and powers of directors, their proceedings and liabilities, the election or other appointment of auditors and their qualification, the accountability of officers of the company holding custody or control of monies, the keeping of accounts and the right of inspection thereof by shareholders, the making of dividends by the apportionment of profits by the directors, with reduction of the company's capital stock, and, after setting aside out of the profits, if the directors think fit, a fund for contingencies, the making of bye-laws, arbitration, and access by all parties interested to the special Act, a copy of which is to be kept at the principal office, and also, in the case of a railway, canal, or other such works affecting more than one town or place, to be deposited with clerks of the peace and town clerks.

Part I. of the Companies Clauses Act, 1863 [26 & 27 Vict. cap. 118], relates to the cancellation and surrender of shares. Part II., relating to additional stock, contains regulations as to the creation and issue of (*a*) new ordinary shares or new ordinary stock, and (*b*) new preference shares or new preference stock, with any fixed, fluctuating, contingent, preferential, perpetual, terminable, deferred, or other dividend or interest not exceeding the rate prescribed in the special Act, and, if no rate is prescribed, then not exceeding the rate of £5 per cent. per annum; moreover, preference shares or stock are entitled to priority of dividends only out of the profits of each year; and, if ordinary stock or shares are at a premium, the offer of new shares or stock to existing shareholders is provided for. Part III. relates to debenture stock, and provides for its creation and issue up to the amount owing by the company on mortgage or bond, with fixed and perpetual preferential interest, the debenture stock to be a charge upon the undertaking prior to all shares or stock of the company, and its interest a primary charge; but holders of debenture stock have no vote. Part IV. relates to change of name—with continuance of powers, liabilities, and rights—of the company.

The Companies Clauses Act Amendment Act, 1869 [32 & 33 Vict. cap. 48], removes the restriction of rate of interest on debenture stock to 4 per cent. per annum, which was contained in the Act of 1863.

The Companies Clauses Acts of 1888 [51 & 52 Vict. cap. 48] and of 1889 [52 & 53 Vict. cap. 37] provide for a proxy to be taken to be a shareholder.

Now, under section 11 (*a*) and 12 (1) of the Light Railways Act, these clauses Acts may, with exceptions and variations, be incorporated in an order; but they are not to apply to a light railway, except so far as they are incorporated or applied by the order. It must be remembered, at the same time, that sections 16 to 80 of the Lands Clauses Consolidation Act, 1845 [8 Vict. cap. 18], must not be subjected to any alteration.

Moreover, under section 11 (*b*) and 12 (1) of the Light Railways Act, the enactments relating to safety, etc., mentioned in the second schedule of the Act, may, if and so far as considered necessary, be included in the order; but they are not to apply to light railways, except so far as they are incorporated or applied by the order authorising the light railway.

These enactments we will now briefly review.

The first on the list is the Highways Act, 1839 [2 & 3 Vict. cap. 45], and the whole Act is under reference. It enacts that the proprietors of a railroad shall make, maintain, and man gates where the railroad crosses any highway or statute labour road for carts or carriages in Great Britain under a penalty of £5 for each day's neglect.

Of the Railway Regulation Act, 1845 [5 & 6 Vict. cap. 55], next on the list, we are only concerned with sections 4, 5, 6, 9, and 10.

The 4th section requires one calendar month's notice to be given to the Board of Trade of the intended opening of a railway, and ten days' notice of its completion for the conveyance of passengers and its readiness for inspection.

Section 5 exacts a penalty of £20 for each day a railway is opened, without compliance with the above order, until the said notices have been duly given and expired.

Under the 6th section, the Board of Trade may postpone the opening of a railway for a month, and so from month to month, as their inspector reports that the same would be attended with danger.

The 9th section refers to the Highways Act, 1839 (the first enactment on the schedule), and, recognising that it is generally safer, enacts that gates at level-crossings be kept closed across the road, unless in certain cases the Board of Trade consider it more conducive to safety to have the gates closed across the railway.

Under the 10th section a railway company is compelled to erect and maintain fences throughout the whole of the line.

Third on the schedule, the whole of the Gauge of Railways Act, 1846 [9 & 10 Vict. cap. 57], is mentioned. It establishes 4 ft. 8½ in. in Great Britain and 5 ft. 3 in. in Ireland as the standard gauge, only to be departed from in the case of certain named railways, and it enacts that the gauge of a railway shall not be hereafter altered. Not only may a penalty be exacted of £10 per mile of line constructed or altered contrary to this Act for each day that it so remains, but the offending railway is liable to abatement.

Of the Regulation of Railways Act, 1868 [31 & 32 Vict. cap. 119], fourth on the schedule, sections 19, 20, 22, 27, 28, and 29 are named.

The 19th section deals with proceedings taken against a company in case of non-consumption by a locomotive of its smoke, and provides that, if the fault lies with the company or its servants and not in the design of the locomotive, the company shall be held guilty of an offence under section 114 of the Railways Clauses Consolidation Act, 1845.

Section 20 requires companies to provide smoking compartments for each class of passengers, unless exempted by the Board of Trade.

By section 22, every company is required, under a penalty not exceeding £10 for each case of default, to provide means of communication between the passengers and the servants of the company in charge of the train; while a passenger using the means of communication without due cause is liable to a penalty of £5.

The remaining three sections deal particularly with light railways, and this, as before mentioned, being the first reference to them by name in an Act of Parliament—sections 27, 28 and 29 may very well be quoted *in extenso* :—

"27. The Board of Trade may by licence authorise a company applying for it to construct and work or to work, as a light railway, the whole or any part of a railway which the company has power to construct or work.

"Before granting the licence the Board of Trade shall cause due notice of the application to be given, and shall consider all objections and representations received by them, and shall make such inquiry as they think necessary.

"28. A light railway shall be constructed and worked subject to such conditions and regulations as the Board of Trade may from time to time impose or make; provided that (1) the regulations regarding the weight of locomotive engines, cariages, and vehicles, to be used on such railway, shall not authorise a greater weight than eight tons to be brought upon the rails by any one pair of wheels; (2) the regulations respecting the speed of trains shall not authorise a rate of speed exceeding at any time twenty-five miles an hour.

"If the company or any person fails to comply with, or acts in contravention of such conditions and regulations, or directs any one so to fail or act, such company or person shall respectively be liable to a penalty for each offence not exceeding £20, and to a like penalty for every day during which the offence continues; and every such person on conviction or indictment for any offence relating to the weight of engines, carriages, or vehicles, or the speed of trains, shall be also liable to imprisonment, with or without hard labour, for any term not exceeding two years.

"29. The conditions and regulations of the Board of Trade relating to light railways shall be published and kept published by the company in manner directed with respect to bye-laws by section 110 of 'The Railways Clauses Consolidation Act, 1845,' and the company shall be liable to a penalty not exceeding £5 for every day during which such conditions and regulations are not so published."

The fifth enactment on the schedule is the Regulation of Railways Act, 1871 [34 & 35 Vict. cap. 78], section 5, which extends the application of sections 4 to 6 of the Regulation of Railways Acts, 1842 (see above), and the Acts amending the same, with respect to the opening of any railway, to such new works as additional lines, deviation lines, stations, junctions, and level-crossings; but the Board of Trade may, in such cases, dispense with the notices required in the said Acts.

The sixth item on the schedule is sections 4 and 6 of the Railway Regulation Act, 1873 [36 & 37 Vict. cap. 76].

Section 4 of this Act obliges a railway company to make to the Board of Trade, by the 15th February in each year, a return in specified forms:—

(*a*) Of the cases in which a passenger line is connected with, or crossed on the level by any other line, siding or cross-over road, and of cases of non-compliance with Board of Trade requirements, in regard to the concentration and interlocking of signal and point levers and to the addition of safety points on goods lines and sidings.

(*b*) Of the various systems—whether by telegraph on the absolute or permissive block or neither, or (on single lines only) on the "one engine in steam" system, or by train porter, or by train staff—on which the different portions of the railway are worked.

In default a penalty of £5 *per diem* may be exacted, unless the Board of Trade have in any case granted exemption.

The 6th section is an amendment of section 6 of "The Railway Regulation Act, 1842" (see above), and empowers the Board of Trade, if it thinks fit, to postpone the opening of a railway for a further period not exceeding one month, without going to the expense of further inspections, and so on from time to time until the requisitions of the Board's officers have been complied with.

Seventh on the schedule is the whole of the Railway Returns (Continuous Brakes) Act, 1878 [41 & 42 Vict. cap. 20], which obliges every railway company to furnish for each half year (ending 30th June and

31st December), in an appointed form, a return of the amount of passenger stock fitted and not fitted with continuous brakes, the description of brakes adopted, and whether they are instantaneous in action, self-acting, universally applicable, in regular use, and of durable and easily maintainable materials. Failures of continuous brakes must be reported in another form of return; and the number of passenger trains run without continuous brakes in a third form.

The eighth enactment referred to in the schedule is section 3 of the Cheap Trains Act, 1883 [46 & 47 Vict. cap. 57]. It ensures the provision of proper third-class accommodation at fares not exceeding 1d. per mile, and of workmen's trains, between 6 p.m. and 8 p.m., at reasonable fares, under the orders of the Board of Trade or—if the company appeal to them—of the Railway Commissioners; otherwise the railway may forfeit the exemption from passenger duty allowed, in respect to fares not exceeding that rate, by this same Act. But, as light railways are free from passenger duty, under section 12 of the Light Railways Act, this penalty would have no force in regard to them.

Ninthly, and lastly, the schedule mentions the whole of the Regulation of Railways Act, 1889 [52 & 53 Vict. cap. 57].

This Act, to which reference was made at the beginning of this chapter, empowers the Board of Trade to order a railway company, within a certain time,

(*a*) To adopt the block system;

(*b*) To interlock their points and signals;

(*c*) To use on all passenger trains continuous brakes, which shall be instantaneous in action, applicable by the driver and guards, self-applying in the event of failure of any of their parts, applicable to every vehicle—whether carrying passengers or not—in regular use in daily working, and manufactured of materials durable and easily maintained and kept in order. "In making any order under this section the Board of Trade shall have regard to the nature and extent of the traffic on the railway," and "shall hear any company or person whom the Board of Trade may consider entitled to be heard." To meet expenses incurred under this Act, debenture stock may be issued on a certificate of the Board of Trade.

The Act contains other provisions. Companies must furnish returns showing overtime of those persons in their employ whose duty involves the safety of trains or passengers. Penalties are laid down for avoiding payment of fare, the offender being liable to a fine of 40s., or, in a second or subsequent case of the kind, to a fine of £20 or imprisonment for one month. Every passenger ticket must have the fare printed upon its face. Finally, the power to make bye-laws, subject to disallowance by the Board of Trade—conferred by the Railways Clauses Consolidation Act, 1845—is extended to bye-laws for maintaining order in and regulating the use of railway stations and the approaches thereto.

Under section 11 (*c*) of the Light Railways Act, an order may contain provisions determining construction details, such as gauge, permanent-way, underbridges, level-crossings, etc.; provisions for working the railway, dealing with station arrangements, method of traction, rolling-stock, train working, etc.; and provisions enabling the Light Railway Company to make agreements with railway or other companies.

If an agreement is made for the working of the line by a railway company, the latter is given the required powers to give effect to the order under section 11 (*d*). Or, if an existing railway company apply for an order to construct and work a light railway as their own undertaking, they may be given the required powers under this section. But they must furnish the certificate called for in the *Rules made by the Board of Trade with respect to applications to the Light Railway Commissioners for orders authorising light railways*, 27 (*l*).*

Under section 11 (*e*), the order may incorporate a company by inclusion of provisions of the Companies Clauses Acts or by the insertion of others.

The Board of Trade appears, under section 11 (*g*), to have independent power to limit and regulate a council's advances or loans.

In section 11 (*i*) discretionary power seems to be given, if the managing body is not a local authority, to include in the order the provisions contained in existing Acts, or to insert others, in regard to the audit of accounts.

Section 11 (*j*) places light railways in the same position as standard railways, in regard to maximum rates and charges for traffic, and the application of rates and charges will, it may be presumed, be controlled by the Railway Commissioners and the Board of Trade in the same manner as standard railways. The official and legal checks, to which railway rates and charges are subjected, have been briefly described in chapter II.

New companies promoting a railway had been required to make a deposit of 5 per cent.; for a railway under the Railways Facilities Act, 1864, the rate was, as we have noted, 8 per cent.; and, under the Tramways Act, 1870, the rate was 4 or 5 per cent. The requirement of such deposits, while schemes were still in the Bill stage, was one of the greatest obstacles to the promotion of light railway projects. When once the Bill became an Act, the grievance would not exist; but, in the initial stage, it was often prohibitory. The Light Railway Commissioners may now, under section 11 (*k*), require, or not require, deposits at their discretion.

In speaking of tramways and the Tramway Act of 1870, it has been observed that the right of pre-emption, severely enforced by some local authorities, was one cause of the failure of that Act. Section 11 (*l*) leaves it within the power of the Light Railway Commissioners to determine, in the order, the conditions under which a local authority may acquire the railway.

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* Appendix IX., *Statutory Rules and Orders*, 1896.

The effect of section 12 (2) must now be examined. Subject, firstly, to the foregoing provisions of the Act, and, secondly, to any special provisions, as indicated, contained in the order, the general enactments relating to railways are to apply; and, for the purposes of these enactments and of the Clauses Acts, so far as they are applied, the Light Railway Company must be deemed a railway company and the order a special Act, and any provision thereof a special enactment, except that a light railway is not to come under the Railway Passenger Duty Act, 1842 [5 & 6 Vict. cap. 79], which levies the following:—

"For, and in respect of, all passengers conveyed for hire upon or along any railway, a duty at and after the rate of £5 for £100 upon all sums received or charged for the hire, fare, or conveyance of all such passengers."

A number of the general enactments, relating to railways, are mentioned in the course of this consideration of the Light Railway Act, and others are quoted in Appendix X. Reference may here be advised to Bigg's *General Railway Acts*.

Under paragraph (1) of section 13 of the Light Railways Act, where an order incorporates the Lands Clauses Acts, any matter which, under those Acts, would be determined by a jury, by arbitration, or by two justices [see remarks on section 11 (*a*)], is to be determined by a single arbitrator who is to be appointed by the parties (or, if they do not agree, by the Board of Trade). The usual 10 per cent., as compensation for compulsory purchase, etc., may or may not be added to the estimated value, but, in making his award, the arbitrator must also take into account the probable increased value of the rest of the property, remaining with the owner, due to the proposed light railway, and this would act as a set-off. Hitherto, the custom has been to assess the disadvantages and to ignore the advantages to the owner.

Under section 13 (2) the Board of Trade may fix a scale of costs for such arbitration.

Paragraph (3) applies the Arbitration Act, 1889 [52 & 53 Vict. cap. 49], to any such arbitration. Thus, a single arbitrator will be appointed, having power to administer oaths or take affirmations; to state an award in the form of a special case for the opinion of the High Court of Justice; and to correct in an award any clerical mistake. Any party to the submission to arbitration may summon witnesses or call for documents by *subpœna*. The court may remit the award to the arbitrator for reconsideration or may set it aside if improperly procured. The award may, by leave of the court, have effect as a judgment or order and be so enforced. Subject to section 13 (2) of the Light Railways Act, the costs of the reference and award lie in the discretion of the arbitrator.

Section 14 of the Light Railways Act authorises the payment to trustees of any purchase-money or compensation not exceeding £500, and provides for cases of doubtful title to, or partial interest in, the land in question. This section extends the amount payable to trustees, on behalf of a partial or limited owner, from £200 (under the Lands Clauses Act, 1845) to £500.

Section 15 (1) applies to any local inquiry held by the Board of Trade, Part I. of the Board of Trade Arbitrations, etc., Act, 1874 [37 & 38 Vict. cap. 40], by which power is given to the Board of Trade to hold such inquiry by any person or persons authorised by the Board, and (as if the application for an order were for a special Act) both promoters and objectors are liable for the expenses, which will be defrayed as the Board may direct.

Under section 15 (2) have been issued the "*Rules, dated September* 1896, *made by the Board of Trade, with respect to applications to the Light Railway Commissioners for orders authorising Light Railways*" (Statutory Rules and Orders, 1896, No. 787). They are quoted in Appendix IX.

According to those rules, it will be observed, in connection with section 15 (3), that a fee of £50 must be paid to the Board of Trade by the promoters before they lodge their application with the Commissioners.

Unless otherwise provided, any expenses incurred by the Board of Trade will, under section 15 (4), be defrayed out of money furnished by Parliament.

Section 15 (5) requires the Board of Trade to present an annual report to Parliament of proceedings taken under this Act.

Section 16 of the Light Railways Act prescribes the manner in which any expenses incurred by local authorities, and allowed by the Commissioners, in connection with an application, are to be paid.

Under section 17 county, borough, or district councils may combine for any purpose in connection with a light railway. County councils may thus combine under the provisions of the Local Government Act, 1888 [51 & 52 Vict. cap. 41], district councils under those of the Act of 1894 [56 & 57 Vict. cap. 73], and where councils cannot appoint joint committees under those Acts the provisions in the third schedule of the Light Railways Act apply.

Any existing company may, under section 18, obtain an order to construct or work, as a light railway, the whole or part of a railway which they already have power to construct or work. They would, of course, have to furnish the certificate required in the *Rules made by the Board of Trade with respect to applications to the Light Railway Commissioners for orders authorising light railways*, 27 (*l*) (see Appendix IX.).

Section 19 prescribes the conditions under which, with the consent of the Board of Agriculture, a landowner may grant land or advance money for a light railway. A landowner within the meaning of the Improvement of Land Act, 1864 [27 & 28 Vict. cap. 114], is, "as to lands in England, the persons who shall be in the actual possession or receipt of the rents or profits of any land, whether of freehold, copyhold, customary, or other tenure, except where such person shall be a tenant for life or lives holding under a lease for life or lives not renewable, or shall be a tenant for years holding under an agreement for a lease for a term of years not renewable, whereof less than twenty-five years shall be unexpired at the time of making any application to the commissioners, without regard to the real amount of the interest of any person so excepted; and in the case where the person in the actual possession or receipt of the rents or profits of any land shall fall within the above exceptions, then the person who for the time being shall be in the actual receipt of the rent payable by the person so excepted, unless he shall also fall within the above exceptions, shall, jointly with the person who shall be liable to the payment thereof, be deemed for the purposes of this Act to be the owner of such lands."

Section 20 provides for the conveyance of Crown lands.

Section 21 guards the acquisition of commons for light railway purposes.

Section 22 is framed to protect natural scenery and objects of historical interest.

Junctions with existing railways will, under section 23, have to be made so as to interfere as little as possible with passenger lines. Passengers—as Sir James Allport said—load and unload themselves. In the case of goods, however, actual connection of the light and main lines would be of the greatest value. This, therefore, is to be desired, but interference with main railway passenger lines is to be avoided. Under the Railway Clauses Act of 1863, the existing main line of railway may provide and work the junction and make the light railway pay for it. This might cost the latter too much, and the Board of Trade may make such conditions as seem to them fair.

Section 24 prescribes the manner in which an order may be amended.

The definition of "Act of Parliament" in the Telegraph Act, 1878 [41 & 42 Vict. cap. 76], "includes a certificate granted by the Board of Trade under the Railways Construction Facilities Act, 1864." It is now, by section 25 of the Light Railways Act, made "to include an order authorising a light railway under this Act." The Telegraph Act, it may be added, grants power to the Postmaster-General to establish telegraphic lines on certain undertakings authorised by special Act of Parliament.

Section 26 applies the Light Railways Act with certain modifications to Scotland. It will be noticed that, while in England parish councils are not included in section 2, two or more parish councils in Scotland may, under the provisions of section 26 (2), combine where there is no district committee.

Section 27 expressly excludes Ireland from the scope of the Act, it being otherwise provided for.

Section 28 defines the expressions "Light Railway Company," "Clauses Acts" [see the remarks on section 11 (*a*)], and "Share Capital."

Finally, section 29 gives the Act its short title.

The general enactments relating to railways referred to in section 12 (2), and not actually mentioned in this chapter, are given in Appendix X. The reader may also consult Bigg's *General Railway Acts*, *The Light Railways Act*, 1896, by Henry Allen Stewart, and *The Light Railways Act*, 1896, by Evans Austin.

CHAPTER XII.

THE QUESTION OF GAUGE.

CONTENTS.—Standard gauge in Europe and U.S.A., 4 ft. 8½ in.—Indian gauges, 5 ft. 6 in., metre, and 2 ft. 6 in.—Comparative cost of these per mile, £7200, £4500, and £1800—Effect of gauge on each item of construction—Effect of gauge on working expenses—M. de Lapparent's comparison—Battle of the gauges in India—Break of gauge and transhipment—Adoption of the metre gauge on main line routes in India—Col. Conway-Gordon's advocacy of Punjab feeder lines on the standard gauge—Choice of gauge now dependent on physical connection with trunk lines—M. Moreau's advocacy of the narrow gauge—Speed as a factor—Capacity of rolling-stock—Standard gauge generally required in England—Economies independent of gauge should be eliminated from the discussion—Mr Walley-Dod's remarks on gauge in India—Sir John Wolfe Barry's views on gauge in England.

Standard Gauge of Great Britain, etc.—The 4 ft. 8½ in. gauge has been adopted as the standard for normal railways in Great Britain and most European countries. It was originally chosen because it happened to be that of the road wagons in the north of England which first ran on railways.

Considering that the stability and speed of trains depended on the angle contained between lines drawn from the centre of gravity of a train-section to the inner edges of the rails, Brunel introduced a broader gauge of 7 ft., which made a splendid road—bridge rails on longitudinals—and existed on the Great Western Railway and its connections until 1892.

There is no practical reason for departing from the 4 ft. 8½ in. standard—which is that of Great Britain, the United States, and, excepting Russia and Scandinavia, of continental Europe—and it is to be regretted that Irish broad-gauge lines are committed to the 5 ft. 3 in. and Indian to the 5 ft. 6 in. standard. Our light railways may be as light as can be, but, if they are of the standard 4 ft. 8½ in. gauge, the main line 8-ton, or even 10-ton wagons, may circulate freely on them. Where the 4 ft. 8½ in. gauge is recognised as the standard, the only alternative should be the 2 ft. 6 in. gauge. Between these two the differences are sufficiently marked to get rid of overlapping conditions.

Indian Gauges.—In India three gauges—the 5 ft. 6 in., the metre, and the 2 ft. 6 in.—have been freely tried. It furnishes us, therefore, with the best examples to assist us in determining the effect of gauge. We may take our figures from the *Administration Report on the Railways of India* for 1895–96.

The average cost per mile of railway open is Rx.16,273, or (assuming, for the purposes of this discussion, that 10 rupees are equal to 12 shillings), £9764 for the 5 ft. 6 in. gauge; Rx.7214 or £4328 for the metre-gauge; and Rx.3342 or £2005 for the special smaller gauges.

Investors or promoters, however, would scarcely accept, for purposes of rough comparative estimate, averages of *all* the railways on each gauge. The older the line—and the broad-gauge railways are the oldest—the greater the cumulative capital expenditure, added to annually and justified by growing business. The older broad-gauge lines were built somewhat extravagantly. The reduction in the price of material and departmental construction (doing away with the big contractor) have put the old figures out of date.

Instead, therefore, of Rx.16,000 or £9600 for the broad or 5 ft. 6 in. gauge, Rx.7000 or £4200 for the metre gauge, and Rx.3333 or £2000 for the smaller special gauges, we should prefer figures based on "modern instances," and regard Rx.12,000 or £7200 as roughly representing the cost of a 5 ft. 6 in. railway per mile, Rx.7500 or £4500 as that of a metre gauge, and Rx.3000 or £1800 as that of a 2 ft. 6 in. gauge line. All the lines averaged would give us ratios of 16 : 7 : 3 very nearly; modern instances correct the ratios to 16 : 10 : 4, or 8 : 5 : 2. These figures are suggested as fairly representative of the comparative cost of a railway in India, according as it is built on the 5 ft. 6 in., the metre, or the 2 ft. 6 in. gauge.

It must not be supposed, however, that gauge is the only—or even the most important—factor upon which the cost depends. We may, perhaps, trace its influence on the cost most conveniently by examining a table which exhibits under each main head the details of mileage cost of the Bengal-Nagpur (standard, 5 ft. 6 in.), the Indian Midland (standard), the Bengal and North-Western (metre), the Rajputana-Malwa (metre), and the Cooch Behar (2 ft. 6 in.) Railways.

On the Bengal-Nagpur Railway (5 ft. 6 in. gauge) the permanent-way consists of 75 lb. flat-footed steel rails on steel sleepers, ballasted throughout with good stone. The line generally is unfenced, except at important stations. The mileage open was 861 miles. On the main line exceptionally heavy bridging of tributaries of the Mahanadi river occurs for 220 miles. On the Umaria-Bilaspur section is a great deal of heavy work in bank and cutting, a tunnel 1200 ft. long, etc. Practically, the ruling gradient is 1 in 100, and the minimum radius of curves 1000 ft. For further details of rolling-stock, traffic, earnings, etc., see the tables in the Appendices.

On the Indian Midland Railway (standard gauge), the permanent-way consists of 80 lb. flat-footed steel rails on oval-pot cast-iron sleepers. The line is fenced throughout. The mileage open was 677 miles. There is only one gradient so steep as 1 in 100, and there are no curves with a radius of less than 1000 feet. There is a good deal of large-span girder bridging.

On the Bengal and North-Western Railway (metre gauge) Tirhoot section, the permanent-way consists of 40 lb. iron (being replaced by 50 lb. steel) or 41¼ lb. steel rails, on wooden or on cast-iron plate sleepers. The line is fenced and ballasted. The country is easy. On the Sonepore-Ajodhya section the country is subject to inundation, and this has involved heavy banking. Bridging the Rapti and crossing the drainage of the Gunduk and Gogra rivers have been expensive. The grades and curves are easy. There is a considerable mileage of unfenced branches.

On the Rajputana-Malwa Railway (metre gauge), the original 36 lb. and 40 lb. rails have already been largely replaced by 41¼ lb. and 50 lb. steel rails. The standard of construction varies considerably over a total open mileage of 1674, but is generally an exceptionally high one. As a rule the gradients and curves are easy. The Rajputana section includes a good deal of bridging, especially the bridge over the Jumna at Agra. There are heavy works on the Malwa section, including the Nerbudda bridge, tunnels, viaducts, etc. on the Holkar railway. A great deal of the line is unfenced.

The Cooch Behar State Railway (2 ft. 6 in. gauge) runs through an easy country, on an embankment 12 ft. wide. The permanent-way consists of 25 lb. flat-footed steel rails, on pyngado sleepers in sand ballast. The bridges are built with metre-gauge girders. The line is unfenced. The curves and gradients are easy, but the quantity of earthwork is increased by a wide formation and embanking the line well above a country liable to inundation.

Relation between Gauge and Cost.—We may now endeavour to see how the figures in the table are affected by gauge.

Upon survey expenses, plant, and establishment gauge has no effect.

In India land expenses are not much affected by gauge. Very often land is a free gift from the Imperial Government or a native state. In any case, its compulsory acquisition is a matter of simple procedure, and, although the price paid in accordance with the assessment of the civil authorities is very rightly a liberal one, it is not excessive. Indeed, so cheap is land that embankments are seldom made up of "spoil" from cutting, but from "borrow-pits" at the side. Thanks to the wise generosity of the Rajput Maharajas, the cost of land does not bulk largely in the capital expenditure of the Rajputana-Malwa Railway; and although, as usual, the line is constructed for a single track, sufficient land has been taken up to admit of another track being laid if necessary hereafter.

The cost of earth-work to formation is the next item. It is one that is very largely dependent on grade and very little on gauge.

The steeper the ruling gradient, the shorter and more direct will be the practicable route in a hilly country; and the sharper the limiting curve, the larger the freedom and flexibility of adjustment that will be possible. Now these are two of the advantages claimed by the

DETAILS OF MILEAGE COST OF INDIAN RAILWAYS OF DIFFERENT GAUGES, FROM THE ADMINISTRATION REPORT OF 1895-96.

Main Head.	Bengal-Nagpur.	Indian Midland.	Bengal and North-Western.	Rajputana-Malwa.	Cooch Behar.	Sub-heads included in Main Heads.
Gauge	5 ft. 6 in.	5 ft. 6 in.	Metre.	Metre.	2ft. 6in.	
	Rx.	Rx.	Rx.	Rx.	Rx.	
Preliminary Expenses .	174	134	54	156	44	Survey expenses, plant, establishment.
Land	69	73	254	59	45	
Formation	1609	4448	314	471	373	Earth-works, tunnels.
Bridge Work	2120		1191	1400	269	Large bridges, minor bridges.
Fencing, etc. . . .	41		264	103	4	Fencing, road crossings, mile and gradient posts.
Electric Telegraph . .	...		...	1	...	
Ballast and Permanent-Way	3516	4057	2325	2249	1369*	*Unballasted.
Stations and Buildings .	725	747	897	1002	140	Stations and offices, workshops, store buildings, staff quarters, station machinery.
Plant	192	56	170	176	32	Engineering, locomotive, carriage and wagon plant, station and office furniture.
Ferries, etc.	...	...	162	...	...	Ferries and floating bridges.
Rolling-stock	1743	851	666	1175	346	Locomotive, carriage and wagon.
General Charges . . .	669	559	401	536	236	Direction, engineering, stores, audit and account, medical and sanitation.
Loss by Exchange . .	76	37	207	...	...	
Total	10,934	10,962	6904	7328	2858	

advocates of narrow-gauge lines, and they offer, especially in a country which presents exceptional engineering difficulties, considerable opportunities for reducing the cost of earth-work and other items of construction. If, however, these difficulties occur at one or two critical points only, and are not characteristic of the line generally, the economy gained in alignment and grading will not necessarily justify the adoption of a narrow gauge.

It must be conceded that, not as a necessary consequence of adopting a very small gauge but as a matter of fact, the haulage of the same amount of paying load on a line of light traffic will generally be weighted with less dead-load on the smaller guage, and steeper gradients, therefore, will be practicable at a pinch.

Adaptation of rolling-stock to sharp curvature is less a question of gauge than of design and of the use of bogies, the adoption of which has greatly weakened the narrow-gauge case. In fact a quotation (to be made later on) from Mr A. M. Wellington's work on *Railway Location* claims an advantage in respect of adaptation to sharp curves in favour of broad gauge. On the Manhattan Elevated Railway in New York, curves of 88½ feet radius are not too sharp for the stock.

Much sharper curves might be negotiated, both on the 5 ft. 6 in. and metre gauges, than those prescribed as the minima in the standard dimensions laid down by the Government of India, so that no special value need be attached to the quotations here made. As a matter of fact, however, a radius of 1146 ft. is the absolute, and of 1910 ft. the preferred minimum, *in ordinary country* for curves on the 5 ft. 6 in. gauge; on the metre gauge, 716 ft. is the absolute, and 1146 ft. is the preferred minimum; and on the 2 ft. 6 in. gauge 238 ft. is the minimum; so that the Government of India limits are considerably in favour of the smaller gauge. *In difficult country*, where economy is most important, a curve of so small a radius as 573 ft. is permitted on the 5 ft. 6 in. gauge, as against 358 ft. on the metre gauge.

Width of formation offers a direct and obvious, but not a very important, advantage to the adoption of a narrow gauge. The saving in earth-work is confined to the vertical strip covered by the difference in width of formation; this difference is 4 ft. 6 in. in cutting, and only 2 ft. 6 in. in embankment, as between the 5 ft. 6 in. and metre gauges; and it leaves untouched the section covered by the slopes, that portion which would remain if the width of formation were *nil*. Even on the Cooch Behar 2 ft. 6 in. gauge line the banks are 12 ft. wide; the minimum is 10 ft. on the 2 ft. 6 in. gauge; 14 ft. on the metre gauge; and 16 ft. 6 in. on the 5 ft. 6 in. gauge. In a country where earth-work is cheap, the difference in gauge offers very little opportunity for economy.

The quantity of earth-work in bank or cutting covered by the slopes increases as the square of the height or depth. The quantity of earth-work depending on width of formation increases simply with the height or depth. The saving in earth-work due to narrowing the width of formation, therefore, becomes proportionately less as the height of embankment or depth of cutting increases; it is, in fact, least important where it is most desirable, in heavy bank or cutting.

Whatever the economy effected by choice of a narrower gauge and formation may be, it is often greatly discounted by building wagons which are almost as wide as those of standard gauge. With slow speeds and small wheels the over-hang may be increased and a reduction of gauge need not mean a corresponding reduction in capacity; but, again, we cannot have wider stock without a wider formation, and thus such economy in earth-work as a narrow gauge might claim very nearly disappears.

Double lines are scarcely within the purview of a light-railway discussion, but it may be interesting to note that the minimum distance between tracks, centre to centre, *outside stations*, permitted by the Government of India is 12 feet for both the 5 ft. 6 in. and metre gauges.

Where, as in India, land and earth-work are not so expensive as in Europe, these items are less affected by gauge. This factor becomes more important when the track is to be laid on a public road or in a street. Then the space occupied by the light railway and left to ordinary road traffic, as well as the width of track to be paved and maintained by the former, depend very directly upon the gauge adopted; every foot of room, every inch is precious; and, if town councillors are thus forced to insist upon a smaller gauge for a light railway invading their town, they are more justified than when they break the gauge, because wagons and trucks might otherwise cross a street or two, startling their sleepy traffic, and spoiling the beauty of their shops and villas.

Much of the cost of bridge-work is not only dependent upon physical difficulties and independent of gauge, but actually independent of the moving loads also.

The longer the span of a bridge, the less important becomes the train-load and the more important the weight of the girder-work itself.

The smaller the span the more do the strength and cost of the bridge depend upon the moving load; and again—as in rails—on the actual load carried, scarcely at all on the gauge of the track; and not only on the actual weight of the train, but on the speed at which it is taken over the bridge. Thus, on the one hand, we ventured for many years in the Punjab to haul broad-gauge trains very slowly and cautiously over bridges designed for the metre gauge; on the other hand, we have considered it advisable to erect metre-gauge girders, ready for future developments, on a 2 ft. 6 in. gauge railway in Bengal. As a matter of fact, on the railway referred to, the embankments and the girders are capable of taking a metre-gauge line to-morrow. With light loads and slow speeds, therefore, there is not very much economy secured by choosing a narrow gauge; and such economy as is possible tends to vanish as the span of the girders increases. While this is true of girder-work, it is equally obvious that the cost of wing walls depends in no way on the gauge; and that the saving on width of abutment and width of piers is not very important, especially where the foundations which carry the piers and abutments are deep and costly, and protective works—a matter absolutely independent of gauge—are on a large scale. A study of the cost and particulars of some of the large railway bridges in India* will show at once that, while the cost per lineal foot varies very much, the gauge is the most insignificant factor of the many which affect the cost.

For comparing the cost of 5 ft. 6 in. and metre-gauge bridges and culverts of smaller span we have ample data in the *Bridge and Culvert Tables* worked out by Mr E. H. Stone, M. Inst. C.E., the present chief engineer of the East Indian Railway, but our quotations must necessarily be brief, and only a few of the more important items can be compared.

Girder Bridges.	Height of Bank.	Two Abutments and One Pier.		One Span.	Gauge.
		Concrete.	Masonry.	Girders.	
	Ft.	Cub. ft.	Cub. ft.	Tons.	
6 ft. span, . .	10	1,579	4,529	0·74	5 ft. 6 in.
,, ,, . .	,,	1,395	3,850	0·48	metre.
12 ft. span, . .	10	1,838	5,159	1·44	5 ft. 6 in.
,, ,, . .	,,	1,634	4,402	1·15	metre.
,, ,, . .	20	3,605	15,644	1·44	5 ft. 6 in.
,, ,, . .	,,	3,321	13,982	1·15	metre.
20 ft. span, . .	10	2,156	6,055	3·14	5 ft. 6 in.
,, ,, . .	,,	1,911	5,137	2·37	metre.
,, ,, . .	20	4,054	17,457	3·14	5 ft. 6 in.
,, ,, . .	,,	3,728	15,528	2·37	metre.
,, ,, . .	30	6,559	38,251	3·14	5 ft. 6 in.
,, ,, . .	,,	6,151	35,007	2·37	metre.
40 ft. span, . .	20	4,461	21,616	9·65	5 ft. 6 in.
,, ,, . .	,,	4,121	19,318	7·66	metre.
,, ,, . .	40	10,259	81,430	9·65	5 ft. 6 in.
,, ,, . .	,,	9,759	75,982	7·66	metre.

From the table here compiled we see that, for girder bridges of small span, the adoption of the smaller gauge does not greatly reduce the quantities, and that the reduction is comparatively less as the height of bank and span of girders increase. Thus, taking the top and bottom figures we find that, while the concrete is 13 per cent. more for a 5 ft. 6 in. girder bridge of 6 ft. span, it is only 5 per cent. more for a 5 ft. 6 in. girder bridge of 40 ft. span, than for metre-gauge girder bridges of the same spans; in the case of masonry, an excess of 18 per cent. at the top is gradually diminished to 7 per cent. at the bottom of the table, and, while a 6 ft. girder is 60 per cent. heavier on the 5 ft. 6 in. gauge than on the metre gauge, a 40 ft. girder is only 26 per cent. heavier. These are sufficiently significant figures.

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* Pp. 50–55, *Administration Report on the Railways in India* for 1895–96, Part II.

In the same way, a reference to Mr Stone's tables for arched culverts, the slopes of the embankment being 2 to 1, would show us at once that the quantities for a culvert on the 5 ft. 6 in. gauge, when the height of bank is h ft., are precisely the same as the quantities for a culvert on the metre gauge, when the height of bank is $h+1$ ft. Without going into details, therefore, it is evident that, while in an embankment 5 ft. high, the difference is 20 per cent., in an embankment 10 ft. high it is only 10 per cent., in an embankment 40 ft. high only 2½ per cent., and so on. Here, again, the saving in expenditure to gauge diminishes as the work becomes heavier, diminishes, in fact, exactly where economy is most valuable.

In open-top and flat-top culverts of 2 ft. span, the percentage of saving in a narrow gauge is much higher than for water-ways of larger span.

Under the main head of bridge-work we must finally admit that difference in cost depends mainly upon physical difficulties, much less upon gauge.

In ballasting, a good deal of difference is made by the gauge. That is obvious. In the list of standard dimensions laid down by the Government of India, we find that the absolute minimum width of ballast at level of foot of rail is 10 ft. on the 5 ft. 6 in. gauge and 7 ft. on the metre—a difference of 3 ft., while the preferred minima are respectively 11 ft. and 7½ ft., a difference of 3½ ft. Moreover, even when the same minimum depth of ballast below sleepers is adopted (as in cuttings in soft soil or on banks), the shallower sleeper of the narrow gauge will materially reduce the total depth of ballast required. So that both in width and depth the reduction in the section of ballast is important.

In permanent-way the difference in cost is largely independent of the gauge. The most important factor is the weight of the rail, and that cannot be expressed in terms of the gauge. Generally and practically it is determined by the maximum weight on a pair of wheels. Even where we have a much lighter section, we have at the same time to reckon with a higher rate of cost per ton. Moreover, when a broad-gauge railway is making a light line, old but serviceable rails of heavy section may be available from main-line renewals, and these may often be cheaper and stronger than new rails of lighter section. The use of second-hand sleepers, however, is not to be advised; new sleepers are more economical.

The maximum weight on a pair of wheels is 15 tons on the 5 ft.

6 in. gauge, 8 tons on the metre gauge, and 6 tons on the 2 ft. 6 in. gauge. The maximum gross weight of engine and tender together permitted on the 5 ft. 6 in. gauge is 86 tons, and on the metre gauge 46 tons. The weight per yard of rail adopted to take these loads on each of the railways compared in the table has been stated above.

The absolute saving in quantity of sleeper-wood may be measured by the ratio of that required on the 5 ft. 6 in. to that required on the metre gauge—9 to 4.

A glance at price-lists will show us that the ultimate economy is reached with the 2 ft. gauge; for the difference in cost per yard of portable railway of 16, 20, 24, or 30 inches gauge is merely a matter of pence.

Stations and buildings are purely a question of accommodation required. How little gauge has to do with expenditure under this main head is indicated by the amounts for the two metre-gauge railways being larger than those for the two standard-gauge lines. On the metre gauge—and much more on lines of less gauge—platforms may be altogether dispensed with. So, in the case of light railways of 4 ft. 8½ in., or 5 ft. 6 in. gauge, they are not absolutely necessary.

Platforms and walls of liberal and uniform height are most particularly required for the accommodation of a suburban traffic, with frequent stoppages, where passengers must enter a train or alight from it as rapidly as possible, and with the least amount of risk. A passenger must be able to take it for granted that, whenever he gets out, he can step on to a platform of exactly the same height that he is accustomed to; he must not be taken by surprise.

To light railways these considerations scarcely apply. The choice seems to lie between a platform of reasonable and convenient height and no platform wall at all, the surface being simply consolidated flush with the level of the rail. Most of the cost of a platform wall is below rail-level, and, while the inconvenience, although not serious, is obvious, the economy of the low platforms which are familiar to us on Continental railways is scarcely to be commended. If, on a light railway, we accept the choice as between a sufficient platform or none at all, we may generally adopt the latter.

In laying out a station yard, the width of the yard and the space occupied by points and crossings, cross-overs, etc., will depend upon the prescribed minimum distance between tracks, centre to centre. The absolute minima in India are 14 ft., 12 ft. 6 in., and 12 ft. on the 5 ft. 6 in., metre, and 2 ft. 6 in. gauges respectively, but the preferred minima—to allow not only for very wide metre-guage stock but for a possible increase of gauge and consequent expansion in the future—are 15 ft. 6 in. and 14 ft. 6 in. on the standard and metre gauges. Sidings fall under the head of "ballast and permanent-way," and the length of sidings required for standing and shunting purposes depends more upon the traffic than the gauge. Indeed, the narrower gauge will require longer sidings to hold the same quantity of goods.

Points and crossings, water columns, turntables, etc., come under the subhead of "station machinery" and main head of "stations and buildings." The minimum diameter of an engine turntable is 50 ft. on the 5 ft. 6 in. gauge, and not more than 36 feet on the metre gauge; that of a carriage or wagon turntable is 18 feet on the 5 ft. 6 in. gauge, and only 14 feet on the metre gauge. These will, however, be required at termini only, and, if land be available, triangles, the cost of which scarcely depends on gauge, may be substituted.

In constructing an engine running-shed, the Government of India prescribe, as the absolute minimum distances between tracks, 10 ft. 6 in. on the metre gauge and 14 ft. on the 5 ft. 6 in. gauge; but they would prefer a distance of 17 feet on both gauges, and such a preference practically ensures its adoption.

On the subject of "rolling-stock," the next item for comparison, it may be said that, absolutely apart from gauge, the expenditure on rolling-stock must depend upon the amount, the nature, and the conditions of the traffic dealt with. The Bengal-Nagpur heads the list, the metre-gauge Rajputana-Malwa Railway comes next, the Indian Midland does with half the expenditure of the Bengal-Nagpur, the metre-gauge Bengal & North-Western follows it very nearly, and the Cooch Behar stock costs least of all.

Between the two 5 ft. 6 in. gauge lines, the Bengal-Nagpur and Indian Midland, the differences in capital outlay, mileage, working expenses, goods traffic in general merchandise, train-mileage, and locomotive stock are not very wide. The differences in gross earnings, net earnings, and mineral traffic are—especially in the last case—much more in favour of the Bengal-Nagpur Railway. When it is observed that only 2849 tons coal and coke are carried on the Midland Railway, as compared with 519,437 tons on the Bengal-Nagpur, it is not surprising that the number of goods vehicles required on the latter is in the ratio of five to three required on the former.

Next, considering the metre-gauge Rajputana-Malwa Railway, we notice that, roughly, its mileage is twice as much, its gross earnings four times as much, its working expenses nearly three times as much, and its net earnings about five times as much as on either of the two 5 ft. 6 in. gauge lines. Its mineral traffic is insignificant (except for its own use), but its goods traffic in general merchandise is four or five times as much. Its train-mileage is four and a half times as much. On the whole, therefore, its employment of more than four times as many locomotives, two and three times as many passenger and goods vehicles, and its expenditure of Rx.1175 per mile on rolling-stock is justified by its traffic, and is absolutely independent of its gauge.

The maximum width over open doors is 13 ft. 3 in. for passenger, and 14 ft. for goods vehicles on the 5 ft. 6 in. gauge; 12 ft. 6 in. for passenger and goods vehicles on the metre gauge; and the maximum width of stock over all (not necessarily the same thing, it will be noticed), 7 ft. 6 in. on the 2 ft. 6 in. gauge. The maximum height above rail level, the minimum accommodation, and the maximum weight on a pair of wheels are also given in the table of standard dimensions in Chapter XIV.

In regard to the main heads of "plant," "ferries," "general charges," and "loss by exchange," no comparison need be made.

The proportion of working expenses to gross earnings is 51 per cent. on the Bengal-Nagpur, 58 on the Indian Midland, 42 on the Bengal & North-Western, 38 on the Rajputana-Malwa, and 64 on the Cooch Behar Railway. This is entirely a matter of traffic, and a high percentage of expenses in earnings is no more against the narrow gauge than a great many other statistics advanced by its extreme advocates are in its favour, purely as a question of gauge.

As a result of our comparison of typical Indian Railways, it is suggested that the actual cost may be roughly represented by Rx.12,000 or £7200 on the 5 ft. 6 in., Rx.7500 or £4500 on the metre, and Rx.3000 or £1800 on the 2 ft. 6 in. gauge. The influence of gauge on each item of expenditure has been generally indicated.

It will be interesting to quote a similar comparison—in lump sum only, not in detail—between French railways on the 4 ft. 8½ in., metre, and 2 ft. gauges.

M. A. de Lapparent* takes £6437 per mile (100,000f. per kilom.) as the minimum cost of a 4 ft. 8½ in. gauge line; £3862 per mile (60,000f. per kilom.) as the average cost of a metre-gauge line, if fixed signals, fencing, etc., are dispensed with, inclines of 25 to 30 millimetres allowed, and sheds for stations (and it will be noticed that this stipulation brings the metre-gauge figures under light-railway conditions which do not directly depend upon the gauge); and £1287 per mile (20,000f. per kilom.) as that of a 2 ft. gauge portable railway on the Decauville or "ladder" system.

The locomotives on the metre gauge referred to by him are very light—15 to 33½ tons,—and, on the 2 ft. gauge, 9½ tons empty and 12 tons in working order. The rails are correspondingly light, less than 20 lbs. per yard on the 2 ft. gauge. The passenger carriages are 5 ft. 7 in. wide.

Battle of the Gauges in India.—The experience of India in the matter of gauges illustrates the inconvenience of having adopted a standard wider than 4 ft. 8½ in. The choice of the 5 ft. 6 in. gauge—for no other reason, apparently, than its being a compromise between the English 7 ft. and 4 ft. 8½ in. gauges—was made in accordance with the advice of an engineer specially summoned from England. This was the first mistake. Were the 4 ft. 8½ in. gauge the standard, locomotive and other rolling stock could be imported from the mother-country at a crisis, and the advantage of this, from a military and political point of view, must be enormous.

Railway development in India was later on checked by the cost of an unnecessarily broad gauge for the purposes of lines of poor traffic. Eminent engineers advocated a 3 ft. 6 in. gauge and estimated the difference in cost—as between that and the 5 ft. 6 in. gauge—at from £784 to £984 per mile; while Mr Thornton,* adding capitalised savings, made it £1000. The drawbacks of transhipment were discounted by Mr Grierson. The disadvantages of break of gauge, from a strategic point of view, were pointed out by Sir W. P. Andrew, and the additional cost and inconvenience of different stock by Mr Bidder. Mr (now Sir Alexander) Rendel wanted a smaller gauge, 2 ft. 9 in., and a 36 lb. rail; and had the 4 ft. 8½ in. gauge been the standard, this—or, better still, the 2ft. 6 in.—should have been the only alternative. The general tendency towards the decimal system of weights and measures, which was prevalent, induced Lord Mayo to decide finally on the metre gauge.

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* *Le Siècle du Fer*, by A. de Lapparent, Paris.

At that time Mr (now Sir Guilford) Molesworth was consulting engineer for railways to the Government of India (1872–89), and his opinion must have been of the greatest value in clearing the question of arguments and comparisons which, as unsound as they are plausible, are still put forward by extreme advocates of one gauge and another.

For example, expert advice would point out that excessive dead load is chiefly due to traffic conditions rather than to the design of the rolling-stock. That the narrow gauge held the advantage in this respect in dense compact loads would be acknowledged, but the broad gauge was most favourable to the carriage of light bulky articles. As a matter of fact the capacity of the metre-gauge carriages and wagons was very nearly equal to that of English stock, and, therefore, equal to all ordinary demands, commercial or military. In conclusion, the matter of dead load might be eliminated from both sides of the question. The narrow-gauge stock would be somewhat better adapted for leaving small consignments at way-side stations. In working, difference of cost did not appear. The real objection to the adoption of two different gauges on main line routes was the break of gauges. It not only established the necessity of separate systems and termini and prevented interchange of stock, but transhipment involved expense, divided responsibility, delays, demurrage, opportunities for pilfering, breakage, loss, and confusion.

So great are these drawbacks from a military point of view that, after the experience of the Afghan War, the line between Lahore and Jhelum, originally constructed on the metre gauge, was relaid to standard gauge and the bridges strengthened accordingly. The steep gradients, requiring the splitting of trains, added to the block of traffic caused by break of gauge, and these also have been reduced at very heavy expense by new works on various alterations of alignment.

The commercial objections to transhipment are less serious. There must be a direct addition to capital cost to provide special sidings, platforms, and receiving sheds. There must also be an addition to the working staff for unloading, sorting, tallying, reloading, clerkage, etc.

The evidence in regard to the working expenses of transhipment is most conflicting. Mr Woodruffe (one of the Victorian Railway

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* Thornton on "Gauge," *Min. Proc. Inst. C.E.*, vol. xxxv., 1872–73.

Commissioners) estimated the cost at 2s. a ton.* Mr Grierson, after observing that the cost, damage, and delay due to transhipment on break of gauge had been very much exaggerated, and pointing out that the greatest inconvenience was felt with mineral and bulky or heavy traffic, considered that its cost was not more than 5d. or 6d. a ton, being less than that involved in the transfer of goods from warehouse to cart, from cart to railway wagon, and delivery at destination.† Mr Bryce ‡ calculates the cost at 6d. a ton. M. Auguste Moreau is sanguine enough to say that the working expenses, due to break of gauge, may be reduced to ½d. per ton, if proper arrangements are made.§ Mr. Money‖ considers the cost equivalent to a carriage of 6 miles. MM. Sartiaux and Banderali estimate it at 2d. to 3d., or exceptionally 4d. per ton.¶ The Clearing House allowance for transhipment, in the days of the G.W.R. broad gauge, was 20 miles. On the Eastern Bengal State Railway the transhipment from broad-gauge wagon to river-flat, across the Ganges, and from river-flat to metre-gauge wagon may be estimated with reference to 250,000 tons and 250,000 passengers, and a total cost for working the ferry of Rx.40,000 or £24,000. The cost, therefore, may be put down at 11d. per ton or per passenger; and this includes (over and above the expenses that would be incurred if the transhipment were directly from wagon of one gauge to wagon of another) a second handling and checking of the goods, the cost of working and maintaining the steamers and flats, the interest on the capital expended on them, the cost of ripping-up and relaying the sidings as one point or another is workable, the varying length of the train journey, etc. Our experience, accordingly, would support Mr Grierson's figure of 5d. a ton, as being an ample estimate of the probable cost of transhipment due to break of gauge only. Mr R. C. Rapier, chairman of the Southwold Railway (narrow gauge), ingeniously claims as an advantage of adopting the smaller gauge on feeder lines, the allotment of 9d. per ton for transhipment to the narrow-gauge line, because this more than covers the cost.

Even the disadvantage of delay may be greatly discounted by good organisation. M. Auguste Moreau asserts not only that bulk has to be broken in any case with incomplete loads, but that as much as ¾ths of all goods, even in full wagons, have to be transhipped. His remarks must, however, be confined to French experience. When he argues that the transhipment of coal and other minerals is least troublesome, he directly contradicts Mr Grierson's evidence in regard to this traffic, and ignores the risk, the damage, and the wastage to which it is exposed. It must not be forgotten, however, that transhipment—independently of break of gauge and quite in the ordinary course of service—has often to be faced in the case of luggage and mixed vans, and that other than complete wagon-loads have to be opened, divided and rearranged.

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* *Transport*, vol. vi., Jan. 1895.

† Thornton on "Gauge," *Min. Proc. Inst. C.E.*, vol. xxxv., 1872–73.

‡ *Engineering*, vol. lviii., Dec. 14, 1894.

§ Foreign Abstracts, *Min. Proc. Inst. C.E.*, vol. lxxxi. pp. 371–5, 1885.

‖ *Min. Proc. Inst. C.E.*, vol. cxxiii., 1895–96.

¶ *The Engineer*, April 10, 1896.

The evils of transhipment are, of course, more especially felt in relation to goods traffic. Passengers—if Sir James Allport's remark may once more be quoted—load and unload themselves.

Many suggestions have been put forward to obviate the delay, the cost, and the inconvenience caused by break of gauge. One is to lift the narrow-gauge bodies off their wheels and to load them up on the broad-gauge truck, an addition of special stock which is not likely to find much favour. Herr Ziffer,* on a system of four rails, would interpose a special brake van, having normal side buffers and a narrow-gauge lower central buffer as well, between the wagons of both gauges, and thus link them up to be hauled by a locomotive on either gauge wherever required for shunting, transhipping, and loading purposes, but the combined movement of standard and narrow-gauge stock on four rails is very seldom required. An English engineer, Mr Everard R. Calthrop, the advocate of 2 ft. 6 in. gauge light railways, has designed a special transportation car on the narrow gauge to carry a broad-gauge wagon, which deserves attention. It is a singular conception, however, to tackle the difficulty of transhipment by making a transportation car, running on a *light railway* of narrow gauge, carry a loaded standard-gauge wagon. The car consists of a low-hung open frame, between which rise the wheels running on the 2 ft. 6 in. gauge, and to the sides of which are fitted two troughs on carriers placed low down on either side along the whole length. On to these troughs the broad-gauge wagon is run, and the difference between the gauges is so great that its wheels easily straddle the frame and wheels of the 2 ft. 6 in. car. Loaded lorrys and farmers' wagons, too, may thus be transported over the 2 ft. 6 in. gauge line without disturbing their contents.

The objections to break of gauge in India, on main-line routes, were chiefly military and political rather than commercial. Not only was the metre gauge acknowledged to be equal to the requirements of ordinary traffic, but it was as capable as English rolling-stock of carrying all sorts of military equipment, artillery, and siege guns. The metre-gauge vehicles were 6½ feet wide, as compared with a width of 8 ft. on the broad gauge. Equally slow speeds would enable the latter vehicles to be made as wide as 11 ft.

It was, at the same time, recognised that statistics of the performance of engines and vehicles purposely designed for slow speeds could not fairly be contrasted with those designed for high speeds; and that comparisons could not be drawn between stock built for dense heavy freight or mineral loads and stock built for light or average freights. In heavy mineral traffic the smaller gauge might have the advantage; but, for the carriage of light and bulky agricultural produce—the principal freight in India—the broader gauge was the more suitable.

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* *Die Einmündung der Schmalspurigen Stiermärkischen Landesbahnen, etc.* Wien, 1894.

Again, with no heavier rail than that required on the metre gauge, the 5 ft. 6 in. gauge light line could take the standard carriage and wagon stock, thus avoiding the break of bulk and splitting of consignments consequent upon a change of gauge and transhipment. And the cost of the light broad gauge line would not be much more.

The result of the discussion a quarter of a century ago was the introduction of the metre gauge, and its occupation of such splendid main-line routes as the Rajputana-Malwa and other paying railways. The capacity of the Rajputana-Malwa Railway was so strained by the increase of traffic that it was proposed to double the road or re-lay the track on the 5 ft. 6 in. gauge. In cost there was little difference between these alternatives. The development of other centres has since relieved it of traffic which might overtax a metre-gauge single line.

The discussion on gauge was again revived in India a few years ago, but rather with reference to feeder and branch railways than to main-line routes.

Colonel Conway-Gordon, R.E., Director of the North-Western Railway, in 1886, pressed for the promotion of light traffic feeder lines on the 5 ft. 6 in. gauge to tap the ever-increasing areas of land opened up for wheat cultivation by the splendid efforts of the irrigation engineers in the Punjab. At the same time, in the Bombay Presidency, branches on the metre-gauge were constructed as feeders to the Rajputana-Malwa Railway. In Bengal the tendency has been to develop light railways on the 2 ft. 6 in. gauge, and in this Presidency a change of gauge may very well be made where vast and wandering rivers in any case break the continuity of railway communication.

The drift of official opinion, six or seven years ago, was in favour of adopting the broad gauge for all future railways, unless there were special reasons against it. At the same time, experience of military difficulties, due to transhipment, as well as the influence of powerful railway companies interested, enforced the advisability of completing missing links in through communication on the metre gauge; but railways adopting this gauge must comply with standard dimensions which would be suitable for the 5 ft. 6 in. gauge also. The conversion of existing lines to broad gauge is subordinated to the construction of new lines. The gauge of feeder lines should preferably be the same as that of the trunk line they are intended to feed; and thus branches connected with the Rajputana-Malwa system have naturally been constructed on the metre gauge, while in Bengal no consideration of this sort opposed the adoption of the 2 ft. 6 in. gauge where it was desired. For railways in connection with frontier expeditions, the Military Department in India last year decided to adopt the 2 ft. gauge, rapid construction being of the first importance, and the line and stock being able to carry all they required. The writer ventures to suggest that nothing less than 2 ft. 6 in. should have been adopted, and that the Public Works Department should not perpetuate the blunder by declaring—as they are said to have done [*]—a decided preference for a 2 ft. gauge to be adopted in future on narrow-gauge feeder lines generally.

Alleged advantages of Narrow-Gauge Stock.—M. Auguste Moreau's demonstration of the advantages of narrow-gauge railways —in the *Memoires de la Société des Ingénieurs Civils*, 1884, p. 537[†] —deserves consideration. Comparing 4 ft. 8½ in. and metre-gauge stock, and assuming that all dimensions are in proportion to the gauge, his conclusion is that the weights of the wagons would be as the cubes of the gauges; so that a metre-gauge wagon would weigh one-third as much as a 4 ft. 8½ in. wagon. The molecular resistance to flexure would be as the squares of the gauges, giving a ratio of 1 to 2. Thus a metre-gauge wagon, weighing one-third as much as, could carry one-half the load of, a 4 ft. 8½ in. wagon. On these assumptions, therefore, the ratio of dead weight to paying load on the metre gauge is only two-thirds of that on the 4 ft. 8½ in. gauge. In practice, M. Moreau admits, these ratios, so favourable to the smaller gauge, do not obtain; and he proposes 7:10 as the practical ratio instead of 2:3, the theoretical ratio.

Further, his view is that metre-gauge stock might be as wide as 9 ft. 2 in. But, on the same conditions, we may widen broad-gauge stock in the same proportion. That for local traffic in small consignments small stock, on whatever gauge, is most convenient has been admitted. M. Moreau does not dispute that bogie stock on the normal gauge will negotiate sharp curves in rough country, but he asserts that the ratio of dead to paying weight is—with full carriages —increased to 8:1 on the normal gauge, as compared with 3:1 on the metre gauge. The value of passenger stock, however, is rather one of facilities than one of tare—bogie stock is, as a rule, for passengers —and any passenger will give his opinion in favour of broad gauge for space, convenience, and facilities.

In regard to break of gauge, M. Moreau reviews the objections, and disposes of them as follows:—Working expenses of transhipment may, if proper arrangements be made, be reduced to ½d. per ton, on which point evidence has been given above. Delay is of little importance, as a day is usually lost in passing a truck from one system to another on the same gauge; but a delay of this sort would scarcely be tolerated in England, although it might be patiently borne in France or India. When M. Moreau observes that the transhipment of coals and other minerals is of little import, the experience of most of us will force us to disagree with him. Not only, according to M. Moreau, must incomplete loads (under present conditions and apart from break of gauge) always suffer transhipment, but, in addition, as much as three-fourths of all merchandise arriving in full wagons. If the circulation of rolling-stock on all lines of the same gauge is so imperfect as M. Moreau indicates, this would appear to be one of those things which they do not manage quite so well in France as in England, or even in India.

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[*] *Indian Engineering*, Sept. 17, 1898.

[†] *Min. Proc. Inst. C.E.*, vol. lxxxi., 1885, pp. 371–75.

The tare, capacity, and cost of rolling-stock depend far more upon the nature of traffic, the material and workmanship, the lowest speed permissible, the smallest diameter of wheels, the possible overhang, etc., than upon the gauge.

"Consequent," says one advocate of narrow gauge, "upon the much lower speed of trains upon the 2 ft. 6 in. gauge, shocks and vibrations are so much less violent, that the diminution of wear and tear is very marked, and it is, therefore, the practice to build under frames, proportionately very much lighter than on the standard gauge."

Quite so, "consequent upon the much lower speed of trains upon the 2 ft. 6 in. gauge," we can do this and many other things; but surely we can reduce the speed without narrowing the gauge. On this point the late Lieut.-Gen. Sir George Chesney, R.E., when on the Indian Council, once observed with quiet humour:—"It is now generally admitted that the old notion of a broad-gauge railway being more expensive to build than a narrow-gauge one is erroneous, and, for my own part, I doubt whether the former could not be made just as cheaply as the latter. The initial cost of the line can be regulated, for the most part, by the rate of speed to be used on it, and some stress is laid on the practical difficulty of maintaining a low rate of speed on a broad-gauge line. *Many of our railways, however, have overcome this difficulty so far with remarkable success.*"

As, whenever this question is discussed, comparisons are made between the tare, dimensions, and load of rolling-stock on one gauge and another, a few more remarks on this subject will be inserted here.

On English railways, goods vehicles capable of carrying 8 tons may not carry a useful load, on the average, of more than 1 ton. The ultimate capacity has little or nothing to do with the average load. A goods vehicle must be capable of carrying a reasonable maximum load, but full loads are far less important than rapid service. If a provincial tradesman wires to a London wholesale house an order for certain goods to-day, he expects to get them to-morrow morning.

In the United States full loads, as well as rapid service, are important to an enormous railway business in grain for export, and stock is built and trains are run accordingly.

Wheat from the Punjab or North-Western Provinces of India demands a steady service, full loads, and heavy trains. Jute in Eastern Bengal strains the carrying power of the railway to the utmost, not only by its quantity, but also by the variations of the market.

On lines of poor traffic, economy and full loads are the first necessity, rapid service a minor consideration.

The standard covered goods steel wagons on the Eastern Bengal

State Railway, 5 ft. 6 in. gauge, are 9 ft. wide and 7 ft. 10 in. high inside, the sectional area thus being 70·5 sq. ft.; their tare weight is 7 tons 10 cwt., and they carry 16 tons 10 cwt. Those on the metre gauge are 6 ft. 7 in. wide and 7 ft. 7 in. high, have a sectional area of 47·7 sq. ft., tare 4 tons 17 cwt., and carry 9 tons 3 cwt. The standard covered goods bogie wagons for the Barsi Light Railway, 2 ft. 6 in. gauge, are 7 ft. wide and 6 ft. 6 in. high inside, give a sectional area of 45·5 sq. ft.; they tare 5 tons 18 cwts., and their load is 14 tons 2 cwts. The maximum weight on a pair of wheels permitted by the Government of India in the case of goods stock is 12 tons on the 5 ft. 6 in. gauge, 7 tons on the metre gauge, and 5 tons (for all stock) on the Barsi Light Railway of 2 ft. 6 in. gauge.

On a light railway — Caen to Dives and Luc-sur-Mer — in Normandy, constructed by the "Decauville" Company on a 2 ft. gauge, are goods wagons of two types, a four-wheeler to carry about 5 tons, and a bogie wagon carrying a standard-gauge load of 10 tons—these weigh only about 3¼ tons each.* The ultimate economy in cost of rolling-stock is certainly reached on the 2 ft. gauge, just as we found in the case of permanent-way. The perusal of a portable railway catalogue shows us that the difference in price between one wagon and another, according as the gauge is 16, 20, or 24 inches, is merely a matter of shillings; yet this difference in cost may cover a serious difference in working capacity.

Rolling-stock depends upon so many factors—not upon gauge only, but upon specification, material, workmanship, nature of goods, consequent capacity required in weight and bulk, strength, stability, speed, etc.—that *ex parte* arguments in proof of the advantages of one gauge or another must be received with the utmost caution.

The late Mr A. M. Wellington† made the following remarks on this subject:—

"As respects rolling-stock, there cannot be a question that there is absolutely no practical advantage in the narrow gauge. Any reputable locomotive builder will contract to build engines of the same weight and power for either gauge, which will traverse the same curves, for the same price. The standard-gauge engine, in fact, will or can have enough shorter wheel base, because of its greater width, to make it take curves a little better—a very important point which narrow-gauge advocates and opponents alike have almost lost sight of.

"The same is essentially true of the cars. The car-bodies may be exactly the same, and the trifling loss from the extra width of trucks,‡ if it were worth discussing at all, may be fully made up by a slight increase in the weight and capacity of the car-body, while car-bodies of the ordinary size and capacity can go safely over any structure or track which will carry a light locomotive—whether standard gauge or narrow gauge—and carry as large a paying load as is customary in narrow-gauge cars."

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* *Engineering*, 28th Feb. 1896.

† *Railway Location*, chap. xxii. pp. 751–752.

‡ Mr Wellington applies the American meaning to the term "trucks," of course. They are under-trucks—generally bogies—which carry the car-bodies.

Standard Gauge generally advisable in England.—It would generally be a mistake in England, in cases where goods traffic is the main consideration, to establish a light railway with a short lead on the narrow gauge, and incur for all goods the expense and inconvenience of transhipment. After all, English standard-gauge stock is not too heavy for draught by horses or pushing by hand; and there should be no difficulty in laying light rails to broad gauge right into a farmer's fields, and shifting the lines as required. If the trucks are to run direct from the fields to the market, our light railways in England must be on the 4 ft. 8½ in. gauge. Locomotives need not run on the farm sidings, but the free circulation of main-line goods stock is not only feasible but desirable. Only on isolated lines, or mining lines, or chiefly passenger lines need the standard gauge be departed from. No absolute rule, however, can be laid down. All that need be enforced here, in regard to English light railways, is that the standard gauge should be adopted, unless there are very strong reasons to the contrary, but the question of gauge must be separately decided in each case on its own merits.

If we lay a light road on the 4 ft. 8½ in. gauge, we may be allowed to run main-line stock on it at slow speeds; if the road is too light for that, we may take on standard goods stock with special light locomotives; and, at the worst, we can employ horses to draw, or we can push by hand, main-line goods stock on unballasted sidings extended into the fields as may be necessary from time to time.

In the last case, however, the easy handling of the so-called portable railways will sometimes be preferred; and we may generally assume that a narrow-gauge line is cheaper to construct, not actually because it is laid on a narrow gauge, but because the reduction in gauge is usually accompanied by other economies which are quite independent of gauge.

Over and over again we have been told that the battle of gauges has been fought and finished. The question has not even died hard, for it is very much alive at the present day, and will assert itself in the consideration of every light-railway project.

Final Remarks on Indian and English Gauges.—In regard to India, Mr F. Wolley Dod has concisely summarized the matter. After observing that the broad gauge, even with a very moderate amount of traffic, works more economically, while the arguments in favour of one standard carry considerable weight, he goes on to say: *—

"The real argument of the opponents of introducing a gauge narrower than the standard in any country is not that a line of 2 ft. 6 in. or 3 ft. gauge, laid with rails of 20 to 30 lbs., and capable of carrying say about ½ ton per foot run at 20 miles an hour, is not cheaper than one of 4 ft. 8½ in. or 5 ft. 6 in. gauge, laid with 80 lbs. rails, and capable of carrying trains weighing 1¼ tons per foot run at 50 miles an hour, but that, if two lines are made, one narrow and one standard gauge, *both equal to carrying the same amount of traffic*, the difference in cost will be inappreciable; that, should the traffic develop, the capacity of the standard gauge can be *gradually* increased at comparatively small cost, and the light rolling-stock and rails gradually replaced by heavier, while the capacity of the narrow gauge can only be increased by either doubling it or converting it to standard gauge, when the rolling-stock, if it cannot be transferred elsewhere, becomes useless, and this cannot be done gradually.

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* *Roorkee Treatise on Civil Engineering Railways.* Fourth Edition. Revised by F. Wolley Dod, F.C.H.

"The system has, in fact, been largely adopted in America of making light lines on standard gauge, and gradually bringing them up to a heavier standard. The disadvantage of having different standards of rolling-stock is a serious one, but it is contended that, even if the passenger and goods vehicles for the light railway of standard gauge be constructed so as to be suitable to the heavy standard gauge, the advantage of having only one gauge more than counterbalances the slight extra expense of original construction.

"It may, therefore, be safely stated as not probable that any line likely at any time to form part of any through system will ever be made in future of a different gauge from the main lines, narrow gauge being confined to mere feeders, or hill railways, which are necessarily at the end of a line, where its advantages are undeniable."

With regard to English light railways, Sir John Wolfe Barry, K.C.B., in his inaugural address* as President of the Institution of Civil Engineers, held strongly that they "should in all cases, other than when they will be independent approaches to a port or to a market, be of the same gauge as the standard gauge of the country." Generally, the traffic would be small and dependent on a main line, and the light railways should, therefore, be able to *carry* the trucks of the main line, thus avoiding the first cost of constructing special rolling-stock, the further cost of maintaining it (with separate repairing shops and staff), and the expense, delay, inconvenience, and losses due to transhipment of such articles as live stock, fruit, fish, vegetables, manure, etc. Sir John Wolfe Barry was a member of the Royal Commission on Irish Public Works, and his statement that the saving due to the adoption of a 3 ft. gauge instead of the 5 ft. 3 in. gauge, in the case of ten or twelve proposed light lines in Ireland, was not more than £500 a mile on the average, is authoritative. But even a larger saving cannot justify a break of gauge. Most of the lines will be so short that the saving in construction, as between standard and narrow gauge, cannot justify the additional expenses and disadvantages of working. When a railway manager now favours a break of gauge, it may be because he dreads their combination and competition in the future, with all their special and favourable conditions. It will be the business of the Commissioners to guard against so remote a contingency, and the business of the public to prevent the prejudicial imposition of a physical obstacle like a break of gauge.

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* *Min. Proc. Inst. C.E.*, vol. cxxvii., 1897.

CHAPTER XIII.

CONSTRUCTION AND WORKING.

CONTENTS.—Statutory rules and orders—Location and grading—Gauge—Land—Width of formation and other dimensions—Ballast—Permanent-way—Timber trestles—Fencing—Level-crossings—Station yards on single line—Signalling and interlocking—Platforms—Turntables—Water supply—Station buildings—Mile-posts and gradient boards—Rolling-stock—Instructions for a light line in India—Approximate cost of light railways in England—Speed—Brake-power—Methods of working single-line traffic—Mixed trains—Fuel consumption—Working expenses—Main line assistance—Terms of working—Economy in staff.

Construction of Railway.—In Appendix IX. will be found the *Statutory Rules and Orders* made by the Board of Trade with respect to applications to the Light Railways Commissioners for orders authorising light railways. Instructions are given regarding the notice to be published in a local newspaper of an intended application for an order; the deposit of the draft order, plan, book of reference, section, estimate, and index plan with local authorities and Government departments; the scales to be adopted on the plans and sections; the previous service of notice on landowners, lessees, and others; the form in which the estimate is to be submitted; the documents to accompany the application; the fees to be lodged with the Commissioners, etc. Applications must be made to the Commissioners in the month of May or November. The order, if provisionally settled by them, requires confirmation by the Board of Trade.

Before a railway can be opened for public traffic, it must be inspected in accordance with Act 5 & 6 Vict. cap. 55, ss. 4, 5, 6; Act 34 & 35 Vict. cap. 78, s. 5; and Act 36 & 37 Vict. cap. 76, s. 6. It has been seriously suggested that light railways, on which the axle-load is limited to 8 tons and the speed to 12½ miles an hour, should be free of all control whatever; but it is only reasonable that the Board of Trade should reserve the right of inspection—in order that they may be assured that their requirements are carried out and their regulations observed—and of imposing such additional conditions for the convenience and safety of the public as may from time to time appear to be necessary.

Economy in construction depends primarily upon the location and grading of the line. In light-railway work especially, direct alignment is of minor importance; every traffic point within reach must be secured, although this may add considerably to the length of the line; saving in distance must be sacrificed to the economy of avoiding heavy works and keeping down the cost of construction. With lighter traffic and shorter trains, moderate undulations of grade may be more readily accepted. A capable driver will know how to take advantage of the acceleration of gravity, if the track is good enough to allow him to raise speed sufficiently to "run at a hill," as Mr A. M. Wellington expresses it. Sharper curves open the way to flexibility of alignment and saving in earth-work in difficult country. The tendency to exaggerate the resistance due to curvature, and to allow too liberal compensation on that account in grading the section, may seriously handicap a promising project. Physical difficulties may often be economically dealt with, in the first instance, by bringing them to a head at one point—by "bunching" grades, adopting special methods of surmounting them, zigzags, etc.,—instead of spreading their treatment over a long section; and improvements in grade and curvature may be made afterwards, when expenditure on them is justified by the requirements of the traffic and the expansion of the revenue of the line. It may sometimes be economical to lay the light railway on a public road, but not generally.

The first temptation to be considered, in the desire for economy, will probably be that of adopting a narrow gauge, and (as has been pointed out in the previous chapter) this does undoubtedly afford an opportunity of saving in several details. It must be borne in mind, however, that facility in running round sharp curves, such as occur in hilly country or with light lines laid on roads, depends rather upon the maximum rigid wheel-base than the gauge; that the occupation of roads is almost as great with a narrow gauge, on account of the width of the stock; and that the adoption of a smaller gauge will scarcely relieve the permanent-way and bridges, unless it is accompanied by a reduction of axle-load, and unless a maximum load per foot of wheel-base is also prescribed. But the question has been discussed elsewhere. It need only be observed here that a difference of gauge should not lightly be accepted if there is any reasonable chance of an exchange of traffic with standard lines.

The occupation of land, by rent or by purchase, at its agricultural value was one of the concessions desired by the advocates of light railways. Under Section 13 (1) of the Act, the compensation may be determined by a single arbitrator nominated by the parties, and the betterment of the property by the light railway is to be taken into account as a set-off. The lawyers will get less, and the owner will get a fair price for his land. Enough land should be taken up in the first instance to leave room for probable future developments lest, having itself raised the value of the adjacent land, the light railway should have to pay for it accordingly hereafter.

In India land and earth-works—two items which bulk so largely in estimates for English railways—are not so costly. Frequently the land is waste, and the price of cultivated land, although it is liberally assessed, is not excessive. Earth-work is cheap for two reasons—(1) because Indian wages are low, and (2) because land can be temporarily acquired outside the permanent land, and embankments made up with earth from borrow-pits dug at the foot of the slope instead of with spoil brought a long lead from cutting.

On single lines in Europe, 4 ft. 8½ in. gauge, the width of formation may be thus determined—

	ft.	in.
Gauge, ...	4	8½
2 Rail-heads, ...	0	5½
Outside edge of rails to toe of slope of ballast, .	9	8
Berms, ...	4	0
Width of formation, ...	18	10

On double line the width of formation will be greater by 5 ft. 2 in. *plus* the actual clearance between tracks—"the six-foot"—which may be 6 ft. or more.

In India the following dimensions apply :—

[Table.

STANDARD DIMENSIONS, INDIAN RAILWAYS.

DETAILS.	5 Ft. 6 In. Gauge.		Metre Gauge.		2 Ft. 6 In. Gauge.	2 Ft. Gauge.
	A	B	A	B		
Formation, Single Line—	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.
(1) Minimum width in embankment,	16 6	20 0	14 0	16 0	10 0	9 0
(2) Minimum width in cutting (excluding side drain),	16 6	18 0	12 0	14 0	10 0	9 0
Curves, Maximum Angle of Curvature—						
(3) In ordinary country,	5° 0′	8° 0′	8° 0′	5° 0′	24° 0′	28° 0′
(4) In difficult country,	10° 0′	6° 0′	16° 0′	10° 0′		
Ballast—	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.
(5) Minimum width at foot of rail,	10 0	11 0	7 0	7 6	6 0	5 0
(6) Minimum depth below sleepers in cuttings in rock or hard soil,	0 9	1 0	0 6	0 9	0 6	0 6
(7) Minimum depth below sleepers in cuttings in soft soil or on banks,	0 3	0 6	0 3	0 6		
Timber Cross Sleepers—						
(8) Minimum length,	8 11	9 6	5 9	6 0	5 0	4 0
(9) ,, breadth,	0 8	0 9	0 6	0 7	0 6	0 6
(10) ,, depth,	0 5	0 5	0 4	0 4½	0 4	0 4
(11) ,, number per mile,	1760	1760	1936	1936	2000	2000

Rails—					Lbs.	Lbs.
(12) Minimum weight per yard,	——	——	——	——	30	30
Weight on a pair of wheels—	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
(13) Maximum for locomotives,	15	15	8	8	6	6
(14) ,, ,, goods stock,	12	12	7	7	4	4
(15) ,, ,, coaching stock,	9	9	5	5		
Total Gross Weight—						
(16) Maximum for tank engine,	——	60	——	32	——	——
(17) ,, ,, engine and tender together, in the case of tender engines,	——	86	——	46	——	——
Maximum rigid wheel base—	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.
(18) For passenger vehicles,	22 0	16 0	15 0	12 0	12 0	10 0
(19) For goods vehicles,	16 0	14 0	12 0	10 0		
Maximum moving dimensions—						
(20) Width of stock over all,	10 6	10 6	8 6	8 6	7 6	6 0
(21) Width of body,*	9 6	9 6	7 9	7 9	——	——
(22) Height above rail level,	13 6	13 6	11 0	11 0	10 0	9 0
Minimum Accommodation—						
(23) Width of seat per passenger,	1 7½	1 7½	1 7½	1 7½	1 7½	1 7½
(24) Floor area ,, ,,	3½ sq. ft.	3½ sq. ft.	3½ sq. ft.	3½ sq. ft.	3½ sq. ft.	3½ sq. ft.
(25) Cubic capacity ,, ,,	25 cub. ft.	25 cub. ft.	25 cub. ft.	25 cub. ft.	22 cub. ft.	22 cub. ft.

A.—Absolute for any railway for all new works.
B.—Recommended for all except unimportant branches.
Items (3) and (4)—The radius of a 1° curve is 5729·578 feet.
Items (10) and (11)—Sleepers to be nearer and deeper on bridges.
Items (13), (16) and (17)—Engines in working order, with full load of fuel and water.

* In the United States the bodies of the cars are 9 ft. wide or more inside (see Voss's *Railway Car Construction*); in England 7 ft. 6 in. wide.

Proposals to cut down the ballast should be received with caution. It may be an expensive item, but in regard neither to its quality nor to its quantity can we afford to be niggardly. Good, clean, and sufficient ballast not only forms a necessary foundation for the permanent-way, but facilitates drainage, and saves sleepers, rails, and fastenings from rotting and rusting. If the ballast train is run on the open line, the engineer must do all he can to get his full value out of it.

The laying of second-hand sleepers is not, as a rule, economical, although it may be necessary in order that a poor line may struggle into existence. In England such a proposal is not likely to be made, and the Commissioners would certainly not sanction it.

The rail is, as Mr A. M. Wellington has observed, the largest single item of expense on a light railway, and upon it "hinges the character of the rolling-stock, the ties, the ballast, and so, to a greater or less extent, almost every other detail of the line." The weight and form of the rail to be adopted is a question of the first importance.

It must not be supposed that the working value of a 40 lb. rail is as much as half of that of an 80 lb. rail; it has only one-fourth of the stiffness and little more than one-third of the ultimate strength, while, in regard to durability, wear must tell more rapidly upon the lighter than upon the heavier section. As a rough rule, however, the weight of the rail in lbs. per yard is commonly taken at five times the maximum axle-load in tons, and in India we carry 15 ton axle-loads on 75 lb. rails. A smaller co-efficient—say 4—might be permitted for light railways worked at slow speeds. At the same time, the Commissioners should not object to the use of second-hand rails—for main lines making light railways may wish to utilise them—provided they are not too much worn, and their actual weight more than covers the rough rule quoted above.

The Vignoles or flat-footed rail, commonly used in India and on the Continent, would be the most economical to adopt on light railways, for it enables us to discard chairs and to use dog-spikes, the cheapest of fastenings. The table given on page 201, although the prices are expressed in rupees, will indicate roughly the saving thus effected.

The cost of the 75 lb. double-headed rail in chairs on wooden sleepers is 14½ per cent. greater than that of the 75 lb. flat-footed rail dog-spiked to wooden sleepers. On light railways a further saving may be effected by discarding the bearing-plates. In that case, the joint or guard sleepers should be double-spiked on the outside of the rails, and on sharp curves every sleeper should be double-spiked on the outside of the outer rail. Coach-screws and clips or fang-bolts may also be used as fastenings, but are more expensive, of course, than dog-spikes. For very light lines on the "ladder" system of portable railways—each section of permanent-way consisting of a pair of rails with its complement of sleepers riveted on—the reader may refer to the illustrated catalogues of Messrs John Fowler & Co. and the Decauville Company.

The intervals between two adjacent running lines of rails on the standard 4 ft. 8½ in. gauge must not, under the requirements of the Board of Trade, be less than 6 ft.; this is also the minimum interval between lines of rails and sidings, but 8 ft. is better. Clearances of 6 ft. and 8 ft. are equivalent to distances between tracks, centre to centre, of 11 ft. 2 in. and 13 ft. 2 in. respectively. These dimensions would apply to light railways on the standard gauge, but the latter are not likely to include double running lines, except for short distances under exceptional circumstances.

WEIGHT AND COST PER MILE OF SINGLE TRACK OF DIFFERENT DESCRIPTIONS OF PERMANENT-WAY IN INDIA.

Description.	Weight.		Cost Landed in India.	
	Tons.		Rupees.	
75 lb. F.F. rails, fish-plates, bolts and nuts, ...	126·54	221·82	13,264	24,233
Transverse steel sleepers and keys, .	95·28		10,969	
75 lb. F.F. rails, fish-plates, bolts and nuts, ...	126·54	253·13	13,264	21,549
Bearing-plates and spikes, . .	10·97		2,272	
Indian timber sleepers, . .	115·62		6,013	
75 lb. D.H. rails, fish-plates, bolts and nuts, ...	127·48	350·48	13,372	33,600
Cast-iron (Denham-Olphert's) plate sleepers, complete, . . .	223·00		20,228	
75 lb. D.H. rails, fish-plates, bolts and nuts, ...	127·48	314·63	13,372	24,678
Cast-iron chairs and spikes, . .	58·59		4,495	
Indian timber sleepers and wooden keys,	128·56		6,811	

Wooden trestling, where timber is cheap and plentiful, is a favourite economy in America. They are, of course, liable to catch fire, but, being recognised as temporary structures, they are supposed to be carefully watched, and it is argued that a properly-designed timber trestle is at any rate better than weak masonry or steel spans. They are not only used as substitutes for high embankments in first construction, but as dry viaducts to be replaced by permanent bridging when the prosperity of the railway is such as to justify expenditure on improvements. The timber troughs and timber bridges which carry the Three Horse-Shoes and Benwick (G.E.R.) light-goods line across the dykes and engine-drains of the fens are described in Chapter XV., but it is doubtful whether such a form of construction would be permitted on a light railway carrying passengers. There is, however, no reason why old wrought-iron girders from the main line should not be used, if they are strong enough to bear lighter loads at slower speeds.

Fencing is not usual on Continental light railways except in populated places. In France the Prefect of the Department may, under the law of 1880, exempt light railways from the obligation (rigidly imposed on the main lines) of providing continuous fencing and level-crossing gates. Fencing, therefore, is seldom provided in country districts, although it may be required in passing through inhabited parts, around station yards and some distance out on each side, to flank level-crossing gates along the line in each direction, or to protect the traffic of a public road. Even in such cases the narrow-gauge lines appear to be privileged (*e.g.*, the station in the streets of Sallenelles on the 2 ft. 6 in. railway from Caen to Dives and Luc-sur-Mer). "The Belgian State Railway," says Mr P. W. Meik,* "has determined to abolish fencing on all light railways, except where there are special circumstances." In Italy, as we have seen, the lines running on the side of the public roads are not fenced. This is true also of the Wisbech and Upwell line in Cambridgeshire, running along the side of a public road, and, had the Three Horse-Shoes and Benwick line been constructed under the Light Railways Act, fencing would not probably have been required in the open fen country.

It will, in England, be difficult to dispense with fencing where the light railway intersects hedges and other boundaries which divide one field or property from another, but, wherever reasonable cause for doing without it can be shown, the Commissioners will not, we may be sure, insist upon the provision of so expensive an item. An American "cattle-trap"—*i.e.*, a grated pit over which the rails are laid on baulks of timber—would, of course, complete the physical boundary where a railway made a gap in a hedge, but such an awful device would never be dreamed of in England.

Elsewhere such cattle-traps are sometimes used at level-crossings, being built across the railway, on each side of the public road, from fence to fence. Cattle and sheep are thus prevented from straying off the road on to the railway, and a gatekeeper need not be placed in charge of the level-crossing, in which case the cost of erecting gates and building a house, as well as the pay of a gatekeeper, are saved.

On Continental railways the gate is frequently kept by a platelayer's wife on small wages, the gate-house being given to them as quarters, so that it is not merely an extra expense connected with the provision of a level-crossing. Our own standard railways are generally forced to carry public roads over or under the lines, not to cross them on the level. But with light railways we shall have to get more accustomed to level-crossings, and to look after ourselves in crossing them. Continental experience is that very few persons are run over, even at unguarded level-crossings. Indeed, we find that, in 1893, on Belgian State railways there were twenty-one accidents (nine fatal) on *watched* level-crossings, and only ten (seven fatal) on *unwatched* crossings; the evidence of the Western of France is that there are not appreciably more accidents on the former than on the latter; * while others report that they have had none. The late Lord Bramwell, who had a very proper contempt for grandmotherly legislation of all kinds, may very well be quoted at this point: †—" But, besides this, I look upon all those rules, regulations, and provisions (*e.g.*, watchmen at level-crossings), which are made to take care of people when they should take care of themselves, as positively mischievous."

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* *International Railway Congress Bulletin*, 1895.

Stations and Signals.—As light railways will, we may assume, consist entirely of single lines, and the stations, therefore, will have to be designed and worked under such very different conditions from those which exist on double-line standard railways, a note written by the author—and issued by the Public Works Department of India, Railway Branch, as *Technical Section Publication, No.* 54—is here placed before the reader:—

'NOTE ON THE DESIGN OF STATION YARDS ON SINGLE LINES IN INDIA.

"*By W. H. Cole, Deputy Manager, Eastern Bengal State Railway.*

"I was asked to make a digest rather than a translation of M. Flamache's paper, ‡ and to add my views on adapting his ideas to our own circumstances in a technical paper for discussion at the next Conference.

"I found that M. Flamache's paper was too concise for abridgment, and that station plans for double lines could not be adapted to single line requirements by simply pinching the two main lines into one. It was scarcely to be expected that we could move so easily from the simpler conditions of double-line working to the solution of the far more difficult and complicated single-line problem.

"We must work out the design of single-line stations from the beginning, and independently; but in doing this we should be guided by the same principles as M. Flamache. Our object should be to avoid occupation of the main lines as much as possible, and to provide refuge sidings for slow trains to allow a fast train to pass or (on our single lines) *cross* them.

"We must also make the best arrangements we can for attaching and detaching vehicles, and—at junctions or traffic-changing stations—for sorting and marshalling goods and mixed trains.

"Having premised so much, I wish to add that Mr P. D. Barclay (Traffic Superintendent, Eastern Bengal State Railway) has not only revised the translation of M. Flamache's paper, but criticised my plans one by one. I am also indebted to Mr A. R. Jacobson (Assistant Traffic Superintendent, Eastern Bengal State Railway) for his opinions and suggestions. In cases of this sort, it seems to me, satisfactory results can only be obtained by friendly discussion between the Traffic and Engineering Officers interested in the question.

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* Meik on "Relaxation of Normal Requirements,"—*International Railway Congress Bulletin*, 1895.

† Stubley *v.* L N.W. Ry. Co. (*L.R.* 1, Ex. 18).

‡ *Bull. de la Comm. Int. du Cong. des Ch. de Fer*, Nov. 1894.

"The simplest arrangement for crossing trains is shown in fig. A,* and involves the use of only one set of points and crossings. An up-train, making way for another, would run direct into siding *a*, but would have to back out on to the main line before resuming its journey; a down-train would back into the siding, and stand there ready to make a direct exit after the other train had cleared the block.

"The next development might take the form either of two turnouts, *a* and *b*, facing each other, as shown in fig. B, or of a loop. Adopting the former, we may place the platform and home signals opposite the points. Next, we may recognise the desirability of shifting the platform to one side or the other, *c* or *d*, and of filling in the intermediate dotted line *e*. Ultimately, we arrive at the plan shown in fig. C, with a 'scissors' arrangement of crossovers, which occupies less space.

"In introducing this plan to my notice, Mr Raynar Wilson (of the Lancashire and Yorkshire Railway, and the author of the excellent series of papers on signalling now being published in *The Railway Engineer*) wrote:—

"'I have some difficulty in speaking of the system of signalling adopted in India, as the conditions—as you remark—are so very different: and, having been trained to having a Board of Trade to deal with, my ideas of economical signalling have been somewhat stunted. Has it ever occurred to you or your colleagues to put in passing loops thus?' And then he sketched the plan shown in fig. C.

"The shunting necks from *a* to *b* and from *c* to *d* must be capable of stabling our longest trains. A down-train has to pass an up-train here; the down-train arrives first, stops at the platform, does its work, proceeds over crossing *e c* to *c d*, and backs into *a b*; it is now in a position—on the arrival of the up-train—to make a direct start from *b* through the crossover *b f*. If the up-train arrives first, after doing its work at the platform, it has merely to back over the crossover *e c* into the siding *c d*, and is then ready for direct exit after the down-train has passed.

"Eliminating the starting and shunting signals, we may bring our main signals right up to the fouling points, as shown in fig. D, or the distance between *e* and *f* being not more than about 300 feet, a two-armed central main signal may be substituted for two separate masts.

"The simpler plan indicated in fig. B has, so Mr Wolley-Dod informs me, been used occasionally in India and largely in America, but I have not had the advantage of seeing this type myself. 'An objection to it is,' he says, 'that two trains arriving about the same

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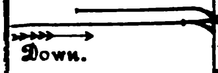
* The figures referred to in this note are those shown in Plate II.



h line.
ain siding.
train siding.
dings.
sidings.
unting line

jj.....reversing line
k......turntable.
ll.....loco line.
mm...branch platform line
nn...stock lines.
oooo...marshalling sidings.
pp,qq..shunting lines.

time actually cross one another's paths, but for all intents and purposes they do so with a loop, if either overruns the loop, and the mere fact of knowing that they do so, without overrunning anything except the signal, would tend to make drivers more careful. The main line points are outside the fouling point between an up-main line train and a down-shunting train; and this gives opportunity for putting the stop signal at the points, and using a simple form of interlocking.'

"The arrangement is, no doubt, 'very compact and convenient,' but for crossing purposes only, I think, and not for possible expansion.

"If we reject the type shown in figs. B, C, and D, we may adopt the other alternative, a loop; and we have then to decide whether we will place our loop on the booking-office side, as indicated in fig. E, or on the opposite side, as indicated in fig. F.

"Of these two, the latter will generally be preferred, because it offers a better view of the straight through line in both directions, and affords room for unlimited expansion,* while the addition of a loop to plan E involves either the setting-back of the platform, as in fig. G, or some such awkward arrangement as that indicated in fig. H. The further development of F will take the form of either I or J, of which plans J is the better; and the next extension will take the form of another loop, as shown in fig. K. In Technical Section publication No. 32 I set forth the advantages of the station plan indicated here in fig. L. All trains enter on the left-hand road, and slow trains to be crossed by fast ones are backed into dead sidings, clear of the through running lines, so that the chances of collision are reduced to a minimum; trains received into the station or running through have to face only one set of points, which they pass on the straight line, and the signalling required is of the simplest description. This type does not, however, seem to commend itself to traffic men. They acknowledge that it is an excellent 'crossing' station, since no less than five trains can be dealt with at one time,—viz., one up- and one down-train in the sidings, one up- and one down-train on the loop lines, and either an up- or a down-train on the main line,—and the standing trains are all in position for proceeding on their journey. But they dislike back-shunting our long goods trains, and object to the time lost in the operation; they prefer the direct entry afforded by more loop lines; they object to being forced to follow the left-hand road always; and they would rather adhere to the present practice of doing all their work on one platform. It may be observed (as in my previous paper) that, if a train has to wait at a station to allow another to pass or cross it, the time may just as well be occupied in shunting into a siding as in standing on a loop; that, on double lines, trains are invariably shunted when another train has to pass them; that a dead siding, while affording the same accommodation as a loop line, is more economical, since it requires only one set of points, and an inferior class of material can generally be used (it can also be provided with trap points to prevent the possibility of a train leaving it when it should not do so, whereas trap points are objectionable in loops through which trains occasionally run at speed); and that the arrangement with several loops, if properly signalled, entails the provision of ten or even twelve signals instead of four, and of much more costly and complicated interlocking.

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* It is, however, a slight advantage to have the straight line, on which fast trains may run through, away from the platform.

"To return to the development of plans A, F, J, K—the next question to consider is the position of the goods shed, platform, and sidings. Shall these be placed opposite, or on the same side as, the booking office? The choice lies between the arrangement indicated in figs. M and N and that shown in fig. O.

"I find one traffic officer preferring plan M to plan O, because, he says, it is more concentrated in arrangement, and the nearer the goods shed is to the booking office, the better supervision over both can be exercised by the stationmaster. Another traffic officer considers that, if the dead siding shown in dotted line in fig. M and in full line in fig. N be added, the goods shed and platform should be built on that siding, as indicated in fig. N; he is of opinion that the goods platform and shed should never be directly opposite the booking office, and he would adopt the plan which I have sketched in fig. O.

"I must say that the concentration is more apparent than real in fig. M, and that, while the distance between the goods shed and the booking office is no greater in fig. O than in fig. N, the stationmaster can supervise the whole much more easily, because both booking office and goods shed are on the same side.

"I think, therefore, that the balance of advantage favours the plan which I have proposed in fig. O; but I would like to develop and improve it in accordance with fig. P. Speaking generally, our passenger and goods business in India lie mainly on the same side of the railway, and the further advantages claimed for plan L apply equally to plan P.

"The next difficulty to discuss is that of junction stations. As the manager of one of our Indian railways reminds me, the real problem at junctions is to deal with mixed trains.

"The nucleus of my idea of such a station is indicated in fig. Q. The main line is double to stations not more than 3 or 4 miles away on each side, in order to clear the junction; down-trains for the branch, or continuing their run on the down main line, and up branch trains proceeding on the up main line, may be dealt with directly; up-trains from the main line running down on the branch may use the reversing line, which will also be utilised when engines have to be changed or reversed, or if a branch train can more conveniently be received on the branch side of the island platform.

"My proposal, in this type of junction station, to double the main lines over short station-to-station distances on each side is in accordance with a suggestion made in *Technical Section Publication, No.* 32, which I here venture to quote for the consideration of those who have not that paper at hand:—

"'The stations adjoining, and next but one to, a junction or traffic-changing station are those which get most blocked under heavy traffic on a single line. The trains tend to crowd one another as they approach the end of the run. Considerable relief would often be afforded if the first two station-distances in each direction were only half the average station-distance, and, further, if the line were doubled as far as the first station in each direction.'

"The diagram in fig. R, where d = average distance between stations, illustrates precisely what is meant.

"The possible development of such a junction-station type as that indicated in fig. Q is suggested in fig. S.

"The object of this design is to offer the utmost facilities for sorting and marshalling vehicles, turning and changing engines, and receiving and despatching trains from and to any of the main or branch lines, and to avoid occupation of the main lines as much as possible.

"Mixed trains, which have to be made up or split up in connection with the division of traffic between the main and branch lines, can be dealt with on the marshalling sidings *o o o o*, which—by means of the shunting lines *p p*, *q q*—can be worked from either end, and are practically separate from the rest of the yard.

"A few glaring instances in this country warn us not to cramp and confine our station by placing it in the fork between the main and branch lines. It should occupy both sides of the common trunk lines in front of the junction, with an island platform between the down main and branch platform lines.

"Wagons to be attached to an up main-line train can be arranged, a new engine can be placed, or a slow train shunted back clear of the main line on the up sidings *d* and *f f*; and the shunting line *h*—although not absolutely necessary—would be very convenient; similar remarks apply to the corresponding sidings *e*, *g g*, and *i*, on the down main line.

"A train proceeding down the branch may be started from either *m m*, the branch platform line, or *b b*, the down main platform line—in other words, from either side of the island platform—according to circumstances; for example, a train already made up, and diverging from the down main to the branch line, would generally proceed directly from the down main side of the island platform; while a train moving on to the branch from the up main line would utilise the reversing line *j j*, shift the rear brake-van, and turn the engine, before making a start from the branch platform line *m m*. The reception of trains from the branch, and their despatch either up or down on the main lines, would be dealt with in a similar manner.

"W. H. C.

"CALCUTTA, 21*st Sept.* 1895."

In so far as the Board of Trade can be moved to relax their requirements in regard to signalling and interlocking in favour of light railways, a very important economy can be effected in construction and working, and the consideration of this question is immediately connected with the arrangement of single-line station yards. Before we discuss the simplifications and economies to be sought for in signalling and interlocking light-railway stations, it will be useful to describe as briefly as possible the functions of signals and the requirements of the Board of Trade on standard railways :—

How much ?

"Fixed signals* consist of home, distant, starting, and siding signals.

"The home signal may be placed at a station (fig. 3, I., H. S., page 209), junction (fig. 3, II., Nos. 4, 6, 8, 10), siding, or signal-box, and is an *absolute stop signal*. It should be placed at a sufficient distance from the fouling point to allow some margin for accidentally drawing a little beyond the signal. No train must pass a home signal at danger, or foul the points or crossings which it protects, except as prescribed in the regulations—*e.g.*, while shunting from one line to the other, or into or out of sidings; or where (at places other than junctions) starting signals are not provided, and it is necessary to bring the train under the protection of the home signal.

"The distant signal (as in fig. 3, I., D. S.) is fixed at a sufficient distance (say 1000 yards, or on a rising gradient 800 yards) from the home signal, and is not merely a repeater of the *home* signal, for when a driver sees the distant lowered, he knows that *both the home and the starting signals* have been lowered. When, however, the distant signal is at danger, the driver must be ready to pull up at it, if necessary; but, if the road be clear, he may proceed cautiously (so that he may stop short of any obstruction) and bring his train to a stand as near the home signal as the circumstances of the case will allow. The distant signal should be distinguished by a fish-tail notch cut out of the end of the arm.

"Starting signals (at stations placed generally at the end of the platform) and advanced starting signals control the departure of trains into the section ahead, and must not be passed, when at danger, except where it is necessary to shunt over points and crossings or cross-over roads close by, when the signalman may allow the shunting to be carried out under his direction. The starting signal (fig. 3, I., S. S.) should not be lowered to allow a train to enter the next section until "line clear" has been received from the station in advance. But, where an advanced starting signal is provided, and the line is clear, the signalman may, if necessary, after bringing the train to a stand, lower the starting signal to allow such train to proceed to the advanced starting signal, and no further. The advanced starting signal thus marks the limit up to which a train may be drawn forward beyond the starting signal, in order to leave the platform line clear, or for shunting purposes, or other station duties. The advanced starting signal is generally placed (as in fig. 3, I.) 300 to 350 yards in advance of the

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* *Notes on Permanent-Way Material, Platelaying, and Points and Crossings*, by W. H. Cole, pp. 126 to 132 (E. & F. N. Spon).

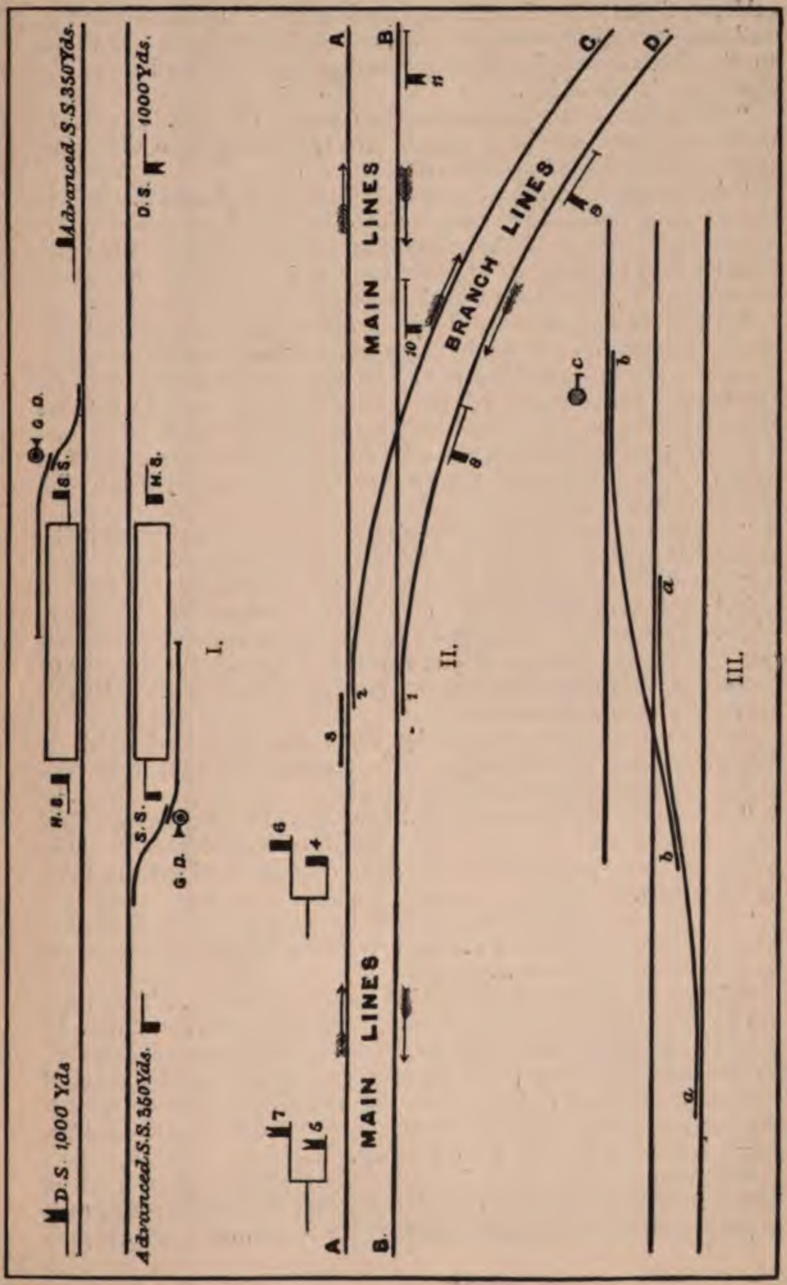

FIG. 3.—Signalling and Interlocking at I., a Station; II., a Double Junction; and III., a Slip Road in a Cross-over Road.

cabin, so that a train of maximum length may clear the section in rear without entering the section ahead, and it should be clearly visible to the driver from the platform starting signal, as well as to the signalman in the cabin.

"Exit from a siding is controlled by a ground disc (fig. 3, I., G. D.) or dwarf semaphore siding signal. No train must leave the siding until such signal has been taken off.

"All signals should be on separate posts or on brackets. Where there is more than one arm on one side of a post, the first or top arm applies to the line on the left, the second arm to the line next in order from the left, and so on; but, if the main or important line be not the one on the left, the signals must be on separate posts or brackets.

"A distant signal must not back-lap a home or starting signal of a station in rear of it. If on the same post as a home or starting signal, its arm must be placed below, and be slotted with or controlled by the upper signal, so that it cannot possibly be pulled off when the latter is at danger. It is a general rule that lamps should be at least 7 ft. apart, so the distant should be 7 ft. below the home or starting signal. At a junction, all distant signals must be controlled by the respective home and starting signal.

"Every signal arm must be weighted, so as to fly to danger if the connection between arm and lever should break at any point.

"The front signal lights are red for 'danger,' and green for 'all right'; the back light (visible only when the signal is at danger) white. This is not obligatory on existing lines, or on new lines run over by companies using a different system of lights. For the sake of distinction, the danger lights of bay starting and other minor signals are often purple instead of red.

"Signals are usually worked by wires, the 'slack' of which is better regulated by hand adjusters in the signal-cabin than by self-acting so-called compensators.

"Having thus briefly described the functions of fixed signals, their approximate positions, and the requirements of the Board of Trade in regard to them, points and crossings in connection with them must be considered.

"Points must be worked or bolted by rods, the effect of varying temperature on rods of 100 ft. and upwards in length being corrected by self-acting compensators.

"Facing points should be avoided as far as possible. They must not be worked from a greater distance than 180 yards, and should be placed as near as practicable to the levers by which they are actuated. In the case of trailing points on the main line, or safety points of sidings, the limit of distance from the levers is 300 yards. This is the English practice, but on the Continent these limits are considerably exceeded, and with perfect safety.

"To secure facing points in their proper position they must be bolted by a locking plunger passing through the stretcher-bar; and, to prevent the signal from withdrawing the bolt while a train is passing over the points, the plunger must be fitted with a locking-bar to suit the longest wheel-base of the rolling-stock. The plunger and locking-bar may be worked either by a separate lever or by the lever which also works the points.

"The first step towards the interlocking of points and signals is the concentration of the levers in one frame.

"The point and signal levers must be so interlocked—that a signal cannot be lowered for a train until the points have been properly set and locked; that any two signals which might lead to a collision cannot be exhibited at the same time; and that, after signals have been lowered for a train to pass, no points connected with, or leading to, the line on which the train is running can be moved. Home or starting signals, next in advance of trailing points, when lowered, must lock the points in either position, unless this locking will unduly interfere with the traffic.

"Points also, if possible, are to be so interlocked as to avoid the risk of a collision by over-running.

"A distant signal must not be capable of being lowered unless the home and starting signals in advance of it have been lowered.[*]

"Detectors must also be fitted, in order to ensure that the points are properly set before the signals are lowered, and to discover any failure in the connections between the levers and the points. Otherwise, if the rods were buckled or broken, a lever might be pulled over without any corresponding movement of the points.

"From the foregoing remarks—in which are included the present requirements of the Board of Trade—it will be seen that there are few absolute rules for the precedence of levers, etc. The interlocking is generally arranged to suit the requirements of the junction or station to which it is applied.

"Whenever it is possible, the interlocking of the point levers (independently of the signals) should be so arranged that the various switches may be set to form a trap or protection, when trains are backing or otherwise. The case of an ordinary double junction may be taken as an example (fig. 3, II., page 209).

"If a train from A on the main line is to proceed on the branch towards C over facing points 2, it is necessary, before making the road from main to branch, to turn over points 1, so that, if a train on the other line B B were backed over points 1, it would not foul the train from A when the latter was crossing the main line B B. The order of working would, therefore, be 1, 2, 3, 4, 5. The levers having been put back in reverse order, a train running over facing points 2 on the main line A A would require levers 3, 6, 7 to be pulled over in succession.

"For a train running on the main line B B over trailing points 1 the order would be 3, 10, 11, so that a train coming from the opposite direction on the other main line could not cross it.[†] If, however, a train from D on the branch were entering the main line over points 1, it would be impossible to trap another train from the main line B B running in the same direction and over the same points. Nevertheless, an accident could only take place through disobedience of signals; for, when the road is made from branch to main line, signal 10 (and, therefore, 11 also) is locked at danger.

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[*] In interlocking this means that the distant signal must also be put back to danger before the home and starting signals.

[†] A passenger train going from A on the main line to C on the branch may be

"Again, where (as in fig. 3, III., page 209) we have a siding or slip road in a cross-over road, the cross-over points *a* should precede the siding points *b*, which in turn would precede the signal *c*.

"It is now required that the starting as well as the home or stop signal shall precede the distant, so that, should a driver approach a station or junction where the distant signal is down, he will know that not only is the station clear but the section in advance also.

"If the distant, however, be at danger, and the home signal only is lowered as described below, the driver will know that the station is clear but the section in advance is blocked, and that he must stop at the station until the starting signal is lowered. The rule is that, so long as the starting signal is at danger, the home and distant signals must be kept at danger, except on the near approach of a train which has to stop at the station, when, after the speed of the train has been reduced so as to admit of its entering slowly and being pulled up at the platform, the home signal may be taken off to admit the train, but the starting signal must be kept at danger until the section in advance is clear; in the case of a train not booked to stop, the home signal must not be lowered to admit the train until the train has been brought to a stand.

"Should the distant and home stand at danger, the driver will know that he must reduce his speed to enable him to stop at the latter.

"In all cases the lowering of the distant signal must backlock the home or starting signal levers, so that they cannot be put back until the distant signal has first been put to danger.

"In sections where the distance is so short that a distant signal is not required, the home or starting signal should be controlled from the station in advance. This is generally done on the signal itself, although there are cases, but very few, where, in mechanical bolt-locking, the lever is governed or controlled.

"The general requirements of a good interlocking apparatus are—

"(1) That there shall be very close locking, *i.e.*, the locking shall act as soon as the lever is moved, and the unlocking shall not be effected until the stroke has been completed;

"(2) That the locking shall be compactly arranged;

"(3) That the locking shall not occupy such space in front of the levers as will prevent the signalman from having the best possible view of the railway, nor such space at the back as will not allow him to stand well up to the levers;

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stopped and made to wait for a goods train running on the other main line B B over points 1, as the former can be trapped and a collision averted if the driver over-runs signals, while the latter cannot.

"(4) That the locking shall not be arranged vertically, which practically prevents a large cabin from being placed across the lines (the most favourable position);

"(5) That, for choice, the locking be arranged in horizontal tiers beneath the floor of the cabin;

"(6) That the locking may be easily got at for cleaning, lubricating, alterations, or repairs, and, so far as possible, without occupation;

"(7) That there shall be as few wearing parts as possible—the less friction, the less the effort to work the levers, and the less wear and tear of the parts;

"(8) That the parts shall be, as far as possible, interchangeable;

"(9) That ordinary repairs, alterations, or additions may be made without the aid of an expert;

"(10) That, although sufficiently sensitive, the apparatus shall not be delicate, or require too much attention;

"(11) That its effective working shall not be affected by variation of temperature;

"(12) That the apparatus shall be capable of extension, if required;

"(13) That the apparatus shall not only be effective in working, but strong, durable, and as simple as possible in construction.

"Of course the engineer in India would be glad to have an apparatus that he could turn out of his own shops, but the economy of that in the long run may be doubted."

On a light railway worked on the "one engine in steam or two coupled" system—which the French more concisely and expressively call "la navette," it is obvious that no signals are necessary; nor are they required at mere stopping-places; nor at intermediate sidings controlled by staff or tablet; but they will have to be provided at all stations where trains cross or pass each other.

In India, as in South America and elsewhere, it has been a common practice to erect a tall mast in the middle of the platform, with one arm to admit an *up* train on either line of the loop, and another arm to admit a *down* train on either line of the loop, without any interlocking whatever. The loops are very long, because full wagon-loads and full train-loads are an essential condition of economical working on most Indian lines, while time is less important. Distant signals are placed at a considerable distance beyond the facing points, and may be lowered quite independently of the main signal, the custom being to lower it *before* the main signal arm is lowered. When the distant signal is at danger the driver must stop with the *tail* of the train protected by the distant signal, and must not proceed until the main signal is lowered, when he may enter the points, pass the main signal opposite the middle of the station, and pull up at the platform in the most convenient position for his train. The points are bolted and padlocked, the keys being held by the head pointsman. The stationmaster is responsible for the facing points being properly set and bolted to admit an incoming train, but the chain of responsibility consists of moral, not of mechanical, links. The scheme may seem to be a very loose one, but it has worked well enough under the strain of considerable traffic on our Indian single lines. Gradually, however, with the growth of business, Indian railways are being forced to revise this crude system of signalling, and to introduce interlocking. The main signals are placed at the facing points, with a separate arm for each road, if a train may be admitted on either; and the main signal is recognised as an absolute stop signal. Distant signals do not precede the main signal, but actually indicate to the driver the position of the arm on the latter. The last step, which really may be deferred without much inconvenience, is to provide starting signals.

On the North-Western Railway of India—of which the writer was recently deputy manager—the ordinary crossing stations are gradually being fitted with List and Morse's patent signals. The practice is to receive the train either on the main line or on the loop line, as may be convenient, and not necessarily on the left-hand road of the loop. This custom is so universal in India that the traffic officers will not listen to any proposal to introduce the English rule. Accordingly, a home signal is erected at the facing points at each end with two arms, one admitting to the main line and the other to the loop siding. The points are locked by keys entrusted by the stationmaster to the pointsman. There are two keys for each end of the station, one for the main line, and one for the loop. When the points have been locked by one of these keys, the pointsman moves a lever which frees the proper signal and locks the key in. The signal can then be lowered from the platform by the stationmaster, and the lowering of the signal locks up the lever at the points, so that the points cannot be again unlocked until the signal has been put to danger by the stationmaster. This places the admission of trains entirely under the control of the stationmaster. The lock on the points is between the rails, so that the key can neither be placed in it nor taken out of it while a train is passing. The distant signal has only one arm, which can be lowered by means of a lever at the points when either of the main signal arms has been lowered, but not before. When the main signal arm is again raised to danger, the distant signal arm is automatically thrown up to danger also.

At the writer's request, Mr A. Morse (Executive Engineer, North Western Railway) furnished a note and plan (Plate III.) for adapting this system to a station yard such as that shown in Plate II., fig. P., with the addition of starting signals, and in accordance with the writer's proposal to admit trains on the left road only, as in England. Mr Morse's note is as follows:—

List and Morse Signals.

"The arrangement shown in the accompanying drawing works as follows:—

"One of the levers in the two-lever frame on the platform, when pulled, works the up home signal, and, when pushed, works the down starter. The other lever similarly works the down home and up starter.

"The signals are interlocked with the points by List and Morse's patent gear on the home-signal post and locks between the points.

"There is one key for each end of the station, and the key will lock the points only for the straight road for a train entering the station.

"When the stationmaster wishes to receive a train, he sends out a pointsman with the key, and the pointsman sets and locks the points for the straight road. The locking of the points releases the setting lever in the three-lever frame at the points, which is then pulled, locking the key in the lock, and releasing the home signal. The stationmaster then lowers the signal by means of the lever on the platform, and the lowering of the signal locks up the setting lever and the key in the points, so that the pointsman cannot shift them. If the signal is thrown up while a train is on the points they cannot be shifted, as the key is in the lock between the rails.

"The starter is worked by a return double wire from the gear on the home-signal post.

"It cannot be pulled until the points are correctly set and bolted, by the plunger of the T-crank gear on the home-signal post.

"The distant signal is worked by a lever at the points; it can only be lowered after the home signal has been lowered, and, if not put to danger before the home signal, it is automatically thrown to danger by the detacher when the home signal is put on.

"If desired, it can be arranged for the distant signal to work from the platform frame instead of from the points.

"Messrs Saxby and Farmer are the sole licensees and manufacturers of the List and Morse signals. Information as to prices can be obtained from them.

"A. Morse,
"*Executive Engineer*, *Lahore District*.

"12th November 1897."

TABLE OF LOCKING.

Key No. 2 locks Points 4 normal and releases Signal 2.
Key No. 9 locks Points 7 normal and releases Signal 9.
Distant Signal 1 is released by Home Signal 2.
Distant Signal 10 is released by Home Signal 9.
Points and Catch 5, 5 is released by key No. 2.
Cross-over 6, 6 is released by key No. 9.
Points 4 reversed releases Starting Signal 8.
Points 7 reversed releases Starting Signal 3.

Taking fig. L. (in Plate II.) as a type-plan for a crossing station on single line, the writer—with the courteous assistance of Messrs Mackenzie and Holland—made two alternative proposals, shown in Plate IV., for signalling and interlocking such stations. These, like Messrs List and Morse's plan, may be regarded as maximum requirements on any light railway.

Plan A was proposed for a loop not more than 1080 ft. long, and, therefore, within the limits of facing-point working from the central cabin. Each train must enter the loop on the left line, and this condition simplifies the signalling very much indeed. Starting signals are not provided. The frame at the centre of the station contains ten working levers, as follows:—

TABLE OF LOCKING, PLAN A, PLATE IV.

No.	Description.	Released by.	Locks.
1	Distant Signal,	2	...
2	Home Signal,	...	3, 5, 6, 9
3	Points,	...	2
4	,,	3	8, 9
5	,,	...	2, 6
6	,,	7	5, 2
7	,,	...	9
8	,,	...	4, 9
9	Home Signal,	...	2, 4, 7, 8
10	Distant Signal,	9	...

Plan B is a very simple arrangement, requiring only a four-lever frame at the centre of the station for working the signals, and a two-lever frame on each side for working the points. Interlocking between the central signal frame and the points frames on either side is effected by means of two siding keys, so that no rigid and expensive connection between the frames by rodding is required. The ground frames *a* and *b* might be placed actually at the points or at any distance from them, not exceeding 180 yds. or 540 ft., towards the station, so as to save time in taking the safety keys to and fro. The plan shows them placed for a loop 2080 ft. long. The trains are admitted on the left-hand road. No starting signals are provided. One siding key cannot be taken out of the central frame *c* to unlock frame *a* until home signal No. 2 has been put to danger, nor can the signal be again lowered until the points have been reset for the left road of the loop, when the key can be taken out of frame *a* and used to unlock frame *c*. The other siding key protects the working of frame *b* and the points and signals at the other end of the yard in a similar way.

The cost for signalling without sidings was estimated at about £220 (fittings delivered f.o.b. London or Liverpool), and with sidings at £280.

TABLE OF LOCKING FOR CABIN, PLAN B, PLATE IV.

No.	Description.	Released by.	Locks.
+	Siding Lock for *a* Frame, ...	...	2
1	Distant Signal, ...	2	...
2	Home Signal, ...	...	+3
3	,, ,, ...	...	⊕2
4	Distant Signal, ...	3	...
⊕	Siding Lock for *b* Frame, ...	...	3

TABLE OF LOCKING FOR FRAME *a* OR FRAME *b*, PLAN B.

No.	Description.	Released by.	Locks.
1	Points, ...	Siding Key.	...
2	,, ...	1	...

In both plans the facing-point locks and lifting bars are worked on the same levers as the points with special escapement cranks. Slip points have ground discs or else scotch blocks. The approach for trains entering the loop is shown as a straight road over the facing points. This makes the entrance easy, but is only of particular importance where trains run through stations at speed.

Nothing more expensive than this should be required of any light railway. In Plan B, rodding—a costly item on standard railways—is reduced to a minimum, and the locking is of the simplest description. But what we really have to settle, in any given case, is the *very least* that ought to be provided in the way of signals, etc., on a light railway.

At a crossing station we may reasonably be called upon to erect a central main signal with two arms, and thus save wire, and to bolt or clamp and padlock our points; if the loop be a long one, it may be necessary to place a home signal at each of the facing points, and to work it from the station platform. Preferably, trains should always be admitted on the left-hand road; in that case a one-arm home signal is all that is required at each of the facing points, and a very simple arrangement will render it impossible to lower the signal unless the points are set for the left-hand road. If trains are to be admitted on either line, the signal must have two arms, but, in this case also, it will not be difficult to make it impossible to lower the signal arm until the points are set in the position to which it applies, and, in lowering that arm, the signal rod may be made to stab the point rod and hold it in position. Distant signals need only be provided where the home signal cannot be clearly seen by the driver from a distance of, say, a quarter of a mile from the facing points, or where the approach is on a steep decline into the station. Starting signals are really not necessary. Wherever junction is made with a main line of railway, it will have, of course, to be signalled and interlocked in accordance with Board of Trade requirements for standard railways.

Considerable saving can be effected if we are able to dispense with raised platforms at stations. If the station is in embankment, and the platform walls have to be carried to some depth to get below the made-up earth, they are costly. If raised platforms are provided at all, they should be of convenient and uniform height; and this is particularly important on a busy suburban line, where the stoppages are short and passengers have to get in and out as quickly as possible. On light railways, however, if the carriages have end doors and steps, passengers will find little difficulty in entering or alighting, even when the ground is merely made up to rail-level. In any case, the principle laid down in No. 11 of the Board of Trade requirements, "that each line shall have its own platform," should, if possible, be adhered to.

In accordance with the requirements of the Board of Trade, turntables of sufficient diameter to take the largest engine and tender in use, without their being uncoupled, must be erected at termini, junctions, and other places where engines have to be turned, except in cases of short lines not exceeding 15 miles in length, where the stations are not more than 3 miles apart, and all trains stop at all stations. The exceptions are likely to cover the majority of light railways in England. Shorter turntables will suffice for tank engines, and triangles may be laid down instead of turntables, if required. If engines which can be driven from either end are used, as on the Belgian light railways, it will not be necessary to turn them.

One or two water-tanks, measuring 8 ft. by 8 ft. by 4 ft., supported on a rail-truss at such a height as will afford sufficient head for the supply of water to the engine from a water column, will probably be all that need be provided at any station where the engine is obliged to water. From the reservoir or well, which is the source of supply, the water may be lifted into the tank by means of a hand-pump.

Station buildings should be constructed on the most modest scale. A small open shed to shelter passengers, a small office, and a goods lock-up may suffice at first.

Mile-posts and gradient-boards will cost very little, and should be provided.

Rolling-Stock.—If the light railway is built to take the goods

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wagons off the main line with which it is connected, there will be a saving in rolling-stock. If a narrower gauge is adopted, separate stock is, of course, absolutely necessary, with separate repairing shops, etc.; while if, with a view to obviating the difficulties and inconvenience of transhipment as much as possible, narrow-gauge bodies are transferred to standard-gauge frames, this not only means the provision of additional stock of special design, but also the provision of special plant for lifting and placing the body. The subject of Rolling-Stock is dealt with in greater detail in Chapter XIV.

Instructions for a Light Line.—The following instructions, laid down by the Government of India in Feb. 1898, for the preparation of the project of the proposed Nowshera-Dargai 2 ft. gauge line, illustrate very well the principal points to be observed in keeping down the cost of a light railway :—

"(i.) Estimates to be prepared for a line starting from the left bank of the Cabul river.

An estimate for bridging that river is not required.

(ii.) Land for a 2 ft. 0 in. gauge is to be estimated for.

(iii.) All culverts to be built of dry stone, or stoneware pipes or trestle bridges with old-rail girders in 15 ft. bents.

(iv.) No fencing need be provided for.

(v.) (*a*) Full ballast should be provided for.

(*b*) Alternative estimates for permanent-way to be prepared, providing (1) for new 25 lb. steel rails and steel sleepers, and (2) for old iron rails and wooden sleepers.

(vi.) Stations and buildings to be sheds only, built of rail uprights, etc., and roofed with corrugated iron sheets.

No platforms are required.

(vii.) Locomotives of the Darjeeling - Himalayan Railway latest type, as noted in the margin, to be provided for.

Under rolling-stock, provision to be made for open trucks on Fox's pressed steel frames without buffers, also of Darjeeling-Himalayan Railway type.

'B class.'—Haul on level, 840 tons.
Incline 1 in 100, 210 tons.
Incline 1 in 26, 50 tons.
Round curve of 60 ft. radius.
Fuel, 39 lbs. coal per mile (average, up and down).
Water, 45 gallons per mile.
Wheels, 4 coupled, 2′ 6″ diameter.
Weight on drivers, 7 tons 10 cwt., and on leaders, 6 tons 10 cwts.

"Two trains each way daily, taking a gross weight of 200 tons, should be estimated for."

Estimate of Cost.—Figures have been given in previous chapters of the cost of light railways in various countries, and they need not be collected and repeated here. The estimates (the amounts of which are given in Chapter XV.) for projects brought forward under the new Act indicate that there is considerable room for reduction in the cost of light railways. Average figures are dangerous things, but, basing them on such meagre information as the writer could obtain, he ventures to place the following before the reader as an example of what might be :—

Earth-works,	£980
Bridges for public roads,	224
Accommodation bridges, etc.,	230
Viaducts, etc.,	352
Culverts, etc.,	113
Metalling of roads,	32
Gates and houses at level-crossings,	40
Permanent-way,	1354
Permanent-way for sidings, etc.,	216
Land and buildings,	874
Stations,	242
Retaining walls, parapets, etc.,	3
Contingencies,	340
Total cost per mile,	£5000

Earth-works and land and buildings are costly items in this list. We ought not to be contented until we are able to regard £4000 per mile as the cost of light railways under average conditions.

Working.—The maximum speed of trains would seem to make the most effective difference between standard and light railways. It certainly opens the way, as we reduce the speed, for securing the utmost economy in construction and working.

In France, as we have seen, the regulation of the speed on light lines lies within the powers of the Prefect. The Western of France,* German lines, Swedish State railways, Danish State light railways, and the Milan Northern of Italy average a working speed of from 22 to 25 miles an hour. On the last-named, it is reported that occasionally they work up to 40 miles an hour. Some secondary lines in France work at 30 and 35 miles an hour. All these railways are satisfied that their ordinary working speed cannot be described as dangerous, although the Danish, German, and Italian lines referred to are not fenced, and the French lines are unfenced in the country. On Belgian light railways the maximum speed appears to be 18⅔ miles an hour in the country and 6 in towns and villages.

In England 8 miles an hour is the maximum speed permitted on tramways, and 4 miles an hour over facing points, etc. On the Wisbech and Upwell line the gradients are very easy, but, with the view of keeping within the maximum speed permissible, the Westinghouse brake is made to act automatically when the speed exceeds 10 miles an hour. Reference is made to this brake in Chapter XV. The maximum speed prescribed for light railways in the Regulation of Railways Act, 1868, was 25 miles an hour, and it is unlikely that the Light Railways Commissioners will allow this limit to be exceeded in any case. They might reduce it to 15 or less on public roads, and to 5 or less in streets, according to the circumstances of traffic. At level-crossings, where no watchman is provided, on curves of less radius than 10 chains, on gradients steeper than 1 in 50, and over facing points not interlocked, a speed of 10 miles an hour might be permitted—possibly less.

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* "Relaxation of Normal Requirements for Light Railways," by P. W. Meik,—*International Railway Congress Bulletin*, 1895.

On ordinary English railways, under the Regulation of Railways Act of 1889, all trains carrying passengers, and all vehicles of such trains, whether carrying passengers or not, must be provided with continuous automatic brakes. Such an order would only be enforced on a light railway where exceptionally high speed was permitted, or very heavy gradients occurred. In India, for many years, our passenger and mixed trains were worked with hand brakes on the engine (in addition to the steam brake) and in the brake vans, of which, on heavy trains, there would be two, manned by the first and second guards, or by a guard in the rear van, and brakesman in the other. On Belgian light railways continuous brakes are in some cases fitted on the locomotives, wagons, and coaches; in others, screw brakes are considered to be sufficient. The "Société Générale des Chemins de Fer Économiques" of France are of opinion that, where the loads and gradients are such as render it necessary to employ two brakesmen, continuous brakes should be adopted; but that, in other cases, the screw brake is better on vehicles, and a steam brake—in addition to the screw brake—on engines.*

In determining the brake power required, very short stretches of incline steeper than the otherwise ruling gradient may generally be neglected. It must not be forgotten that brakes will sometimes be required not so much for the safe working of the train on gradients as in order to pull up or reduce speed and thus prevent collision with foot or cart traffic.

On gradients not exceeding 1 in 100 one vehicle in rear provided with a manned or automatic brake would probably be considered sufficient, and one—or, on goods trains, even two—vehicles might, in order to avoid delay, be attached in rear of that braked vehicle.

Where steeper gradients than 1 in 100 occur, sufficient brake power, either manned or automatic, would in each case have to be provided in rear, to stop any portion of a train breaking away during the ascent of the heaviest gradient. On gradients of 1 in 40, and steeper, the provision of automatic brakes might be insisted upon.

In the Chapter on "Hungary," the proportion of brake power per cent. of gross train weight recommended, on a scale of gradients, by the "Union des Chemins de Fer Allemands," is quoted in the form of a table, and Mr C. E. Hodson (Director of Construction, Railway Branch, P.W.D., India) has kindly furnished the writer with a useful note on this subject, together with the table which embodies his results:—

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* Plocq on "Brakes,"—*Bull. de la Comm. Internat. du Cong. des Chemins de Fer*, vol. viii., 1894.

"1. The brake-power necessary for the safe working of steep inclines is required for two distinct functions, viz.:—

(*a*) To ensure efficient control of the train when *descending* the incline; *i.e.*, to check excessive speed over it, and to enable the driver to stop the train altogether within a reasonable distance, when required.

(*b*) To ensure that, in the event of the breaking of a coupling in the train when *ascending* the incline, sufficient brake-power shall be at once applied, either automatically or by hand, to prevent the rear portion of the train running back down the incline.

"2. Obviously a portion of the brakes required for the *first* function need not be either automatic or manned, but may be weighted or pinned down, if the gradients are tolerably uniform, or, if stoppages are permissible, at convenient places where the grades change. But for the *second* function none of the brakes can be pinned down, but all must be capable of immediate application when necessity arises, *i.e.*, they must all be either manned or else arranged to act automatically.

"3. Let—

$\pm\frac{1}{I} = \pm i$ = the fraction representing the gradient,

and let it be $\begin{cases} +\text{, if the gradient is ascending,} \\ -\text{, if the gradient is descending.} \end{cases}$

$\frac{1}{R} = r$ = the ratio of the resistance to motion on the level, at the given speed, to the gross weight of the train or portion thereof, under consideration.

$\frac{1}{F} = f$ = the coefficient of friction due to the brake, *i.e.*, the ratio of the retardation due to a fully-braked vehicle to the weight of the vehicle.

$\frac{1}{B} = b$ = the ratio of the weight of the portion of the train (including engine and tender) which is braked to that of the whole train.

V = the speed in miles per hour;
v = " " feet per second; $\Big\}\ v = \frac{22}{15}V$.

H = the "velocity head" in feet, due to speed of the train $= \frac{v^2}{2g} = \frac{V^2}{30}$, neglecting the rotative energy of the wheels,

$=\frac{V^2}{28}$ approx., including the rotative energy of the wheels.

D = the distance within which the train may be brought to a stop.

Then, generally,—

$$\frac{H}{D}=\frac{1}{R}+\frac{1}{BF}\pm\frac{1}{I}$$

$$=r+bf\pm i.$$

$$\therefore b=\frac{\frac{H}{D}-(r\pm i)}{f}$$

"4. In order to calculate the proportion of brake-power necessary to fulfil the *first* function, it is necessary to decide on one or other of the two conditions for work on the level, viz.:—

(*a*) The distance in which a train moving at a given speed ought to be stopped.

(*b*) The proportion of the weight of a train which if braked, is considered to give sufficient control on the level; let this be b_0.

The relation between these two is

$$\frac{H}{D}=r+b_0f$$

on the level.

Substituting this in the equation for the grade,—for, presumably, the ratio $\frac{H}{D}$ (which expresses the relation between the speed and the distance of stop) should be the same on the grade as on the level,—we have—

$$r+b_0f=r+bf-i$$

$$\therefore (b_1-b_0)f=i$$

$$\because b_1=b_0+\frac{i}{f}$$

$$=\frac{\frac{H}{D}-r}{f}+\frac{i}{f}$$

$$=\left(\frac{H}{D}+i-r\right)\frac{1}{f}$$

Of this, the quantity $\frac{i}{f}$ may, if desired, consist of weighted or pinned down brakes, leaving only $b_0=\frac{\frac{H}{D}-r}{f}$ to be applied automatically or by hand, when necessity arises.

"5. The minimum of brake-power necessary to fulfil the *second* function is that which will just counteract the force of gravity on the incline, *i.e.*—

$$0 \mathrel{\overline{<}} r + b_2 f + i$$

$$\therefore b_2 \mathrel{\overline{<}} \frac{i - r}{f}$$

This proportion must, as stated above, consist entirely of either manned or automatic brakes, and it must be maintained for every section of the train which is likely to break away from the leading engine, *i.e.*, the weight of the leading engine must be excluded from it, though that of any engines pushing at the rear end of the train, when ascending the grade, may be included in it.

"6. In order to use the above formulæ, it is necessary to assume values for the constants r and f. Of these, r may vary from 5 to 25 lbs. per ton, and depends principally upon the style and condition of rolling-stock and upon the proportion of the weight of the engine to that of the weight of the train. Its exact value is, however, of small importance on steep gradients; so, probably, $r = 0{\cdot}003$ is near enough for practical purposes.

"7. The other coefficient, f, depends principally upon the condition of the rail, and upon the adjustment of the brake gears and the power used to actuate them; and it also varies with the speed, being less at high speeds than at low ones. For low speeds, with a dry rail and good gear, it may be as high as 400 lbs. per ton, but in slippery weather may be 100 lbs., or even less. Rankine* gives $f = 0{\cdot}14$, and probably this is near enough for ordinary conditions, provided the proportions resulting from it are not cut down too fine.

"8. The value of $\frac{\mathrm{H}}{\mathrm{D}}$ must also be fixed, and probably may be taken as $= \frac{1}{42}$ for light railways in England. This gives 50 yards for stopping at 10 miles an hour, 200 yards at 20 miles, and 450 yards at 30 miles an hour, which ought to be sufficient under usual conditions.

"9. Taking these data, the formulæ become—

$$\mathrm{D} = \frac{3}{2}\mathrm{V}^2$$

$$b_0 = \frac{\frac{1}{42} - \frac{1}{300}}{0{\cdot}14} = 0{\cdot}148 = \frac{1}{7}\text{ nearly.}$$

$$b_1 = 0{\cdot}148 + \frac{i}{0{\cdot}14} = \frac{2 + 100\,i}{14}$$

$$b_2 \mathrel{\overline{>}} \frac{i - 0{\cdot}003}{0{\cdot}14} = \frac{100\,i}{14} \quad \text{nearly.}$$

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* Rankine's *Civil Engineering*, 1894, art. 110.

"10. From these we get the following *minimum* proportion of brake power required for various grades, viz. :—

Gradient.		$b_2 = \frac{100\,i}{14}$		$b_1 = \frac{2 + 100\,i}{14}$	
$\frac{1}{G}$	Per Cent. 100 i	All manned or automatic, and exclusive of the leading engine.		of which a quantity $= b_2$ may be pinned down. This proportion includes the engine.	
Level	0	0	0·0000	$\frac{1}{7}$ =	0·143
1 in 200	0·5	$\frac{1}{28}$ =	0·0357	$\frac{5}{28}$ =	·179
1 in 108	1·0	$\frac{1}{14}$ =	·0714	$\frac{3}{14}$ =	·214
1 in 66·7	1·5	$\frac{3}{28}$ =	·1071	$\frac{1}{4}$ =	·250
1 in 50	2·0	$\frac{1}{7}$ =	·1429	$\frac{2}{7}$ =	·286
1 in 40	2·5	$\frac{5}{28}$ =	·1728	$\frac{9}{28}$ =	·321
1 in 33·3	3·0	$\frac{3}{14}$ =	·2143	$\frac{5}{14}$ =	·357
1 in 28·6	3·5	$\frac{1}{4}$ =	·2500	$\frac{11}{28}$ =	·393
1 in 25	4·0	$\frac{2}{7}$ =	·2859	$\frac{3}{7}$ =	·428
1 in 22·6	4·5	$\frac{9}{28}$ =	·3214	$\frac{13}{28}$ =	·464
1 in 20	5·0	$\frac{5}{14}$ =	·3571	$\frac{1}{2}$ =	·500

"11 Of course such formulæ must be used with due regard to varying circumstances. They might easily be put in the form of a diagram."

There are several systems of working single-line traffic, *e.g.* :—

Only one engine in steam, or two or more coupled together, on the line at the same time;
Train porter or guard pilot;
Train staff;
Train staff and ticket;
Electric tablet or staff;
Block telegraph (sometimes admitting a second train into a section under the "permissive block" system);
The Highland Railway system, no train being allowed to cross another or pass another otherwise than as prescribed in the time-table, except under telegraphed instructions from head-quarters;
The line-clear and caution message.

The staff system gives rise to considerable trouble and delay, if there is a break-down. The electric staff or tablet is also expensive, requiring a separate wire and special instruments, besides the wire and instruments used for ordinary telegraph purposes.

The line-clear and caution message system is very common in India. A telegraph wire from one station to another, and ordinary talking instruments at each station are used. After the signaller has ascertained that the line between his station and the next is clear, a line-clear certificate or permission to proceed to the next station is issued to the driver. On railways where caution messages are permitted, it having been ascertained that the line is occupied only by a train running in advance, a caution certificate allowing the driver to follow on with caution, after a certain interval, may be issued.

As is sometimes the practice in Belgium and in France, the telephone may be used instead of the telegraph for communication between stations.

The running of mixed trains will often be necessary for working the traffic economically on light railways. It is not usually permitted on standard railways, and only under certain conditions. The engine, tender, and passenger vehicles must be provided with continuous brakes; the goods wagons must be placed behind the passenger vehicles, with one brake van for every 10 wagons; the mixed train must not consist of more than 25 vehicles of all descriptions; the maximum average speed between stations shall not exceed 25 miles an hour; and mixed trains must stop at all stations.*

Gauge appears to have no necessary connection with economy in the consumption of fuel. During the year 1896 the following was the consumption, stated in terms of Giridih (Kurhurbaree) best steam coal, on certain Indian railways:—

Standard Gauge.	lbs. per train-mile.	lbs. per 1000 gross ton-miles.
East Indian,	60·93	165·59
North-Western,	41·89	132·97
Oudh and Rohilkhund,	39·66	128·43
Eastern Bengal State,	48·01	155·56
Metre Gauge.		
Bengal and North-Western,	28·40	138·88
Rajputana-Malwa,	35·42	169·23
Southern Mahratta,	32·55	187·64
Assam Bengal,	37·59	213·71
Eastern Bengal, Dacca Section,	32·65	231·15
Jodhpore Section,	27·83	148·45
Bickaneer Section,	26·91	150·48

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* Orders made by the Board of Trade under the *Regulation of Railways Act*, 1889.

The metre-gauge train burns less coal than the standard-gauge train because it is lighter, not because it runs on a narrow-gauge line. The East Indian trains burn more coal than the others, because they are heavier; the expense is less, because the coal is cheaper. Every one knows how rapidly the cost of coal increases with the distance it has to be brought from the mines; the average cost of coal on the East Indian Railway is only Rs.1·91 per ton; on the Bombay, Baroda, and Central India, on the North-Western, and on the Madras railways it is more than Rs.15; and there is a corresponding difference in the working expenses. With a home supply of fuel, good traffic, efficient maintenance of way and rolling-stock, and favourable grades, the fuel expenditure ought to be kept at a low figure.

Dividing the working expenditure by the train mileage, he following figures for the year 1896 imply differences of working conditions which upset any attempts to connect them with differences of gauge:—

Railways in England and Wales, Scotland, and Ireland, . .	2s. 10d. per train-mile.
Easingwold Railway, . . .	1s. 4¾d. ,, ,,
Southwold Railway, . . .	2s. 5¾d. ,, ,,
Indian standard gauge, . .	2s. 9½d. ,, ,,
Indian metre gauge, . . .	1s. 11d. ,, ,,
Indian special gauges, . .	1s. 10½d. ,, ,,
Caen to Dives and Luc-sur-Mer, France, 2 ft. gauge, in 1895, .	1s. 4d. ,, ,,
Cape Government railways, 3 ft. 6 in. gauge, in 1897, . .	4s. 3·3d. ,, ,,

The Indian standard-gauge railways include a considerable mileage of military, as distinguished from commercial, lines.

The average cost of hauling for one mile one passenger unit is as low as 0·69 pie or 0·057d. on the East Indian Railway, and as much as 1·51 pie or 0·126d. on the Indian Midland; that of hauling 1 ton of goods is no more than 1·63 pie or 0·136d. on the East Indian; while it comes to 4·12 pies or 0·343d. on the Indian Midland, both being standard-gauge lines. The metre-gauge figures vary even more widely; the cost of hauling a ton of goods is generally higher, amounting, in two instances, to more than 6 pies or ½d.

The percentage of working expenses on gross earnings of Indian railways in 1896 was 47·17 on the standard gauge, 50·56 on the metre, and 54·80 on the special gauges. On all the railways in the United Kingdom it was 56, on the Scottish railways separately it was 51, and on the Irish railways 55.

Good management and bad statistics sometimes go together. Few and fully loaded trains will give a comparatively high figure of cost per train-mile. Putting on an extra train, for which there is a distinct demand in the interests of the public, will add to the cost per ton-mile. Statistics based on train-mileage—being a measure of necessary work done to satisfy public demands—are likely to be preferred in England. Statistics based on ton-mileage will be more favourable to the conditions prevailing in America or India. The most careful economy cannot procure a low percentage of working expenses on receipts, if the traffic is poor and the lead is short.

Very great assistance and encouragement may be given to light railways by the great companies to which they contribute traffic. Junction facilities may be freely granted. The carriage of material for revenue, as well as construction purposes, may be charged at home-line rates. The cost of additional works at junction stations should be fairly shared. Existing accommodation may be placed at the disposal of the light line. Joint station expenses may be wholly borne by the main line, if the work done for the light railway entails no increase of staff or equipment. Repairs of rolling stock for the light line should be carried out in the workshops of the main line at cost price. The division of earnings may be in proportion to capital cost, if the main line works the branch. When the light railway contributes traffic which has a long lead on the main line, earnings should not merely be divided on a mileage basis; the branch bears more than its share of the working expenses in that case, and should be awarded profits in the same proportion.

If a light line is constructed by the State or others and leased to a company, the terms of remuneration to the latter should be such as to make the company work the railway in the interests of the public, and by doing so increase its own profits. The formulæ proposed by French and Belgian experts have been discussed at some length in Chapters III. and IV. The terms on which a main-line company offers to work a feeder light railway generally assume a much more simple form. Thus, the North-Western Railway of India has named certain branches which, if made, it would probably be able to work for about 55 per cent. of the gross receipts.

One important point in economical working must not be forgotten —the reduction of the station and train staff to a minimum. Every official on a light railway should be ready to do anything that may reasonably be required of him. The duties of the *employés* should be interchangeable. The economies thus effected on the Easingwold Railway have been described in detail. Others have been pointed out with reference to Continental light railways. Clerical work should be cut down as much as possible.

CHAPTER XIV.

LOCOMOTIVES AND ROLLING-STOCK.

CONTENTS.—Electricity as a motive power—Various systems of applying it—Telpherage—Electrical traction on steep gradients—Electrical traction in England—City and South London—Central London—Liverpool Overhead—Motor cars or separate locomotives—Claret-Vuilleumier system—Overhead wire and trolley for light railways—Electrical traction in the States—Belt line tunnel—Overhead and trolley system practically universal in the States—Nantasket Beach line—Heilmann electric locomotive in France—Steam generally best for goods traffic—Other methods of traction—Quantity of rolling-stock required—Dimensions of rolling-stock—Four or six-wheels coupled tank engines—Adhesion, tractive and hauling power of locomotives—Goods stock—Passenger stock—Belgian light railways stock—Decauville stock—Eastern Bengal State railway stock on three gauges—Barsi light railway stock.

Electrical Traction.—Our choice of motive power on light railways lies practically between steam and electricity. The claims of the latter deserve particular consideration when the service to be provided is a regular and frequent one of comparatively light trains carrying passengers. For an almost continuous traffic of this sort, with loads which vary little from the average, electricity is eminently suitable, demanding no very great expenditure on generating plant and mains to begin with, and offering a fair prospect of economy in working; while every addition to such a service would, if steam were adopted, call for an increased number of locomotives, and an increased expenditure on fuel and other running requirements. In tunnels the difficulties of ventilation would be largely minimised by electrical traction; and in the streets of towns—where the noise, smoke, dust and smell, due to the use of steam, are especially objectionable—electricity has obvious advantages. Although, therefore, steam locomotives may long continue to be regarded as the most economical and practical movers of irregular and intermittent traffic of the usual kind in the open country, they have less opportunity of exhibiting their speed and power in the neighbourhood of ordinary street or road traffic; and more and more shall we see them displaced by electric motors on our underground railways and the lines which serve our cities and suburbs.

The dynamo-electric machine was known, first of all, as a means of producing electrical energy by an expenditure of mechanical work.

When it was also recognised that its function could be reversed, and that it could act as a motor to perform mechanical work when supplied with energy in an electrical form, its applicability to purposes of railway traction began to be determined. Electrical traction* may be applied in several forms:—

I. Storage batteries may be employed to drive the motor, the batteries and motors being carried—

(*a*) in the car, which is to be preferred as more economical, if space is available, or—

(*b*) on a separate locomotive.

II. Various conductor systems are more commonly adopted—

(*a*) Ordinary rails may be used as conductors, but are unsuitable to urban lines where the rails lie flush with the surface of the road;

(*b*) Nor is the use of a third insulated rail—laid in the centre of the track—above ground suitable in such cases.

(*c*) Overhead conductors—either the wire and trolley arrangement, or slotted tubes and contact carriages in the form of pistons sliding in the tubes—and, for light railway purposes, the wire and trolley system is pre-eminently suitable and economical.

(*d*) Underground conductors in a slotted channel or conduit are less suitable to street or road work, and are much more expensive.

(*e*) Messrs Ayrton and Perry devised a system, by which the line was divided into short sections, each having an exposed conductor—it might be one of the rails—placed, as the train passed over it, in temporary contact with a well-insulated conductor in a closed underground channel by means of automatic electro-magnetic switches. Leakage was thus reduced to a minimum.

Another method of electrical locomotion, known as "telpherage," was proposed by the late Prof. Fleeming Jenkin, and developed by him in conjunction with Messrs Ayrton and Perry. It was intended for the slow carriage of goods in localities where the traffic was not enough to pay an ordinary railway, and has been tried in Japan and some of our own colonies. The line itself is singular, consisting of a steel rod or cable, suspended from brackets fixed to posts erected about 70 ft. apart. This rod or cable is not only a carrier of trains, but a conductor of the motive power—electricity. If the "telpher" line is made more rigid, the trains may be carried at higher speed. Generally, however, it is flexible, and the trains are run slowly, but, if the traffic requires it, they can be run in an almost continuous stream. The train consists of a series of buckets or skips, hung from a single wheel, or a pair of wheels, and they are spaced by wooden bars. The locomotive is formed by a small electric motor hanging below the line, and connected by spur and chain gearing with a pair of driving wheels. In general, the line is electrically divided into sections of nearly the same length as that of a train. The train is furnished with a continuous conductor from end to end, through which it makes electric contact between the section in front and that behind, and the motor is included in the circuit of this conductor.

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* *Encyclopædia Britannica*, "Traction."

The ease and rapidity with which electrically-moved cars can be stopped or started even on steep inclines—a cruel strain on horses—render them singularly suitable for tramway purposes. Their speed can be checked or graduated to meet any requirement or emergency. Far steeper gradients can be faced on such lines than on other adhesion railways, owing to the reduced dead weight of the motive apparatus, and the gain in tractive power where motor-cars are used; so that in America* short gradients of 12 per cent. are not unknown, while gradients of 8 per cent. are common. The steep line from Florence to Fiesole, which may be known to the reader, is worked by motor-cars weighing 7·5 tons, with a tractive force of one-fifth of this weight, or 1·5 tons. The locomotives of the City and South London Electrical Railway (which the writer had the privilege of visiting shortly after its being opened), in hauling—including their own weight—as much as 30 tons up a gradient of 1 in 14 with sharp curves, develop tractive energy equal to a coefficient of adhesion of one-fourth, such as must be expected, observed Dr Preller,† from a good electrical locomotive, as compared with a coefficient of adhesion of only one-sixth or one-seventh in the case of steam locomotives.

It is very remarkable that this application of electricity has hitherto in England been almost entirely confined to such special and important works as the City and South London Railway, the Liverpool Overhead Railway, the Waterloo and City Railway, and the deep-level lines which are now being carried under the crowded thoroughfares of London.

On the City and South London † the generator station is at Stockwell. There are eight Lancashire boilers and four vertical compound engines, each driving a generating dynamo of the Edison-Hopkinson type. The switch board is so arranged that any of the four generators can be coupled to any of the four feeders either independently or in parallel. Two of the feeders are connected to the working conductors at Great Dover Street Station, 12,800 ft. distant. The other two are coupled in parallel to Stockwell, and one is continued to the Oval, where it is connected to working conductors, 14,330 ft. from the generator station. The cables consist of a stranded core of 61–14 B. W. G., insulated and sheathed with lead. They are carried along the tunnels on bracket supports. The working conductors consist of channel steel laid between the rails, and carried on glass insulators fixed to alternate sleepers. Each locomotive is provided with three collectors. The return circuit is through the uninsulated rails. The armatures of the motors are built directly upon the axles of the locomotives, while the magnets are supported partly on the axle and partly on the frame. By thus adopting the principle of direct driving, the necessity of gear of any description is done away with, and the mechanism is, therefore, as simple as possible. There are two direct-acting motors on each locomotive, each motor capable of developing 50 h.p. at 25 miles an hour.

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* *Min. Proc. Inst. C.E.*, vol. cxxv., "The Limiting Gradients on Adhesion Tramways," by F. Denizet, For. Abs.

† *Min. Proc. Inst. C.E.*, vol. cxii., "Hopkinson on Electrical Railways," 14th Feb. 1893.

The locomotives for the Central London Underground Railway[*] are built by the General Electric Company at Schenectady, U.S.A., in accordance with the specification of the British Thomson-Houston Company. The tunnels have a bore 11 ft. 6 in. in diameter. The lines are carefully graded for starting and stopping with the assistance of a series of comparatively steep descents and ascents from and into stations. Trains of seven carriages will afford seating accommodation for 336 passengers, and weigh 105 tons loaded, exclusive of the locomotive. Of these carriages, 32 will be required in regular service. All trains are to be fitted throughout with the Westinghouse air-brake. The maximum speed is estimated at 30 miles an hour, and the average speed (including halts of twenty seconds at stations) at 14 miles an hour. The following details of the locomotive are given :—

Distance between wheel centres of each truck,	5 ft. 8 in. and 6 ft.
Distance between two truck centres,	14 ft. 8 in. and 14 ft.
No. of wheels, all driving,	8
Diameter of wheels,	42 in.
Total wheel base,	20 ft. 4 in. and 20 ft.
" length of locomotive,	20 ft. 8 in. and 28 ft.
" height "	9 ft. 4½ in. and 9 ft. 8½ in.
Weight of each wheel,	about 5 tons.
Total weight of locomotive,	" 24 tons.
Maximum draw-bar pull required at starting,	14,000 lbs.
Draw-bar pull running at 22 miles per hour,	8,000 lbs.
Weight of each motor frame complete, with field coils in place,	6,500 lbs.
Weight of the armature complete, with sleeve and conductor,	2,500 lbs.
Total weight of motor,	12,000 lbs.

On the Liverpool Overhead Railway motor carriages are used, and Mr Greathead admitted that, if there was head-room and the motors could be placed under the carriages, and if the trains were short, motor carriages were to be preferred, because the weight hauled was reduced and terminal shunting avoided. On the City and South London, however, there was no room for the motors under the carriages, the curves were too sharp to admit of longer carriages being built, and, it being a question of the multiplication of vehicles in any case, it was decided that separate locomotives should be provided.

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[*] *Street Railway Journal* (International Edition), March 1898.

The economy of the motor-car, as compared with haulage by a separate locomotive, may be illustrated by Mr W. Baxter's analysis* of the weights in two given cases. He takes a five-car train and gives the following figures:—

	Tons.		Tons.
5 passenger cars, . .	162·50	5 cars, ...	162·50
Steam locomotive, .	85·00	Electric motors, . .	22·00
105 passengers, . .	6·36	105 passengers, . .	6·36
	253·86		190·86

In the latter case the weight of the motors is not more than 11·5 per cent. of the weight of the train, while the weight of the whole train is also reduced by 25 per cent., with a corresponding saving in driving power.

There is in England a very strong objection to the multiplication of overhead conductors in our large towns, and this is largely responsible for the small number of electric tramways hitherto constructed in this country. The use of accumulators, of the present types, has proved to be commercially a failure, owing to the high cost of maintenance; while underground conductors, on the culvert and slot system, are rarely adopted, on account of the heavy expense—amounting to as much as £1500 to £2000 per mile—of their construction. Nor is the underground conduit generally accepted as a satisfactory solution of the question of electric traction in our streets, because of the width of the slot; although at Buda-Pesth this is made as narrow as three-quarters of an inch. A better solution, it has been suggested, is to be found in another example, that of an electric railway in Paris on the Claret-Vuilleumier system† of conveyance by underground conductors, which was brought forward when the accumulator system had been proved to be a failure. The current for the motors is collected by brushes fixed underneath the cars and pressing on a rail flush with the surface of the ground, the track serving as a return. This rail is in sections, each a little shorter than a car, and each group of 18 sections is connected by rubber cables to an automatic apparatus called a "distributor," which is the feature of the system. The sections of each group are successively excited by the distributor as the car passes over them, those not covered by a car being insulated. A spare distributor is carried by each car, and can be substituted for a faulty one in a few minutes. To prevent horses from slipping, the conducting rail is made up of metallic blocks, eight feet apart, embedded and insulated in bitumen, and connected in pairs by a cable below the surface. Each collector, therefore, which is formed of an iron band pressed down by springs, must be more than eight feet long. Public lighting by arc lamps, along the city portion of their line, is also carried out by the tramway company. This method of picking up the current from a series of contacts placed in the surface of the road is not altogether free from chance of accident, for last year * two horses were killed by treading on one of the blocks, which somehow remained electrically "alive" after the passage of the car; but it appears to be less expensive than the culvert and slot conductor, and more suitable for electrical lines in crowded thoroughfares.

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* *Min. Proc. Inst. C.E.*, vol. cxxvi., "Electric Transportation," by W. Baxter, jun. For. Abs., 1896.

† *Min. Proc. Inst. C.E.*, vol. cxxvi., "Electric Tramway in Paris," by Ch. Jacquin. For. Abs., 1896.

In the Belt line tunnel, Baltimore, U.S.A.—where electric locomotives are, for facilitating ventilation, employed to haul the trains, steam locomotives included—the current is conveyed to the motors by an overhead line 17 to 22 ft. above rail level. The conductor consists of an iron trough formed of two Z-bars and a cover-plate, there being a slot one inch wide between the bars to admit of a brass shoe travelling in the conductor, and connecting the locomotive with it. Copper cables are used as feeders, and the current is supplied from generators coupled direct to Allis-Corliss engines. The locomotives have eight driving wheels, and weigh 95 tons each.

That, however, is a special illustration of electrical traction being applied in the tunnel of a great railway. It is to the overhead wire, so successfully and universally adopted in America, that we must look for a sufficiently economical method of applying electric power to light railways. The almost universal system in the States is that of a motor-car, from which a trolley-wheel is projected to run along the under side of a suspended wire, which receives its current from a generator station.

We have heard a great deal about unsightly poles and wires, but there seems to be no reason why they should be hideous; and it is difficult to discover any reasonable objection to their erection in our broader suburban streets, on our district roads, or in the open country. Of this type we had, until recently, but two examples in England, the Leeds and the South Staffordshire Tramways; but already there are signs of progress in this direction, and a proposal has lately been put forward to connect the tramways of Leeds and Bradford by a light railway, the cars to be propelled by electricity, and the trolley arrangement with overhead wires to be adopted. It has been far otherwise in America. In the United States there were 5851 motor-cars and 3532 miles of electrically-worked lines in 1892, 40,000 motor-cars and 10,363 miles of line in 1896; and the mileage of such lines must now be much more than 15,000, a great number of them being what would be called in England light railways, running from point to point, and sometimes on public roads.

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* *Saturday Review*, 29th May 1897, "The Progress of Electric Traction," by Silvanus P. Thompson.

There are many reasons for this extraordinary development of electrical tramways in America, while horse traction has so persistently survived in England. A bus or cab can pull up for us close to the kerb-stone ; our streets, paved with wood or asphalt, offer little more resistance to the horses that draw our cabs and busses than would rails, while they are generally too narrow or too crowded to admit of even a partial occupation of a fixed track by a certain class of vehicles, for the conditions of our street traffic demand the free movement within a limited space of innumerable units among one another. In the United States, on the other hand, the road surface is not favourable to the use of busses or cabs, and carts and private buggies run most easily within the tram track ; the inhabitants of the cities are essentially a car-riding people, and the tram lines are frequently laid down as a matter of pioneer speculation, and the streets are laid out and built to accommodate them.

Attention has already been drawn to the ease and celerity with which electric cars can be started or stopped, and their speed increased or decreased as emergencies may require, and to their remarkable suitability to a traffic which entails a uniform and continuous service with frequent halts. Thus, on the Nantasket Beach line* the electric motor-cars are able to make a run of 10·6 miles with sixteen stops in twenty-six minutes, to do so with such regularity that they connect with boats arriving at intervals of half-an-hour, and frequently to make way for regular steam trains on the main line of the Plymouth Division. When we consider that this leaves but four minutes at the terminus for unloading, running round the trail-car, and loading, and wonder how such a constant and punctual service can be maintained, we are told that the reason why electricity can do this and steam cannot, is found in the tremendous accelerating power of properly-designed electric motors with rotary motion as compared with the reciprocal motion of ordinary locomotives.

It is to this propulsion by a continuous and uniform rotary movement, instead of the alternative movement of two pistons, that the smooth yet swift motion of the start effected by the Heilmann electric locomotive on the Western Railway of France is attributed. On a trial trip† a train of twelve carriages, weighing 150 tons, was hauled 37 miles at a speed of 18 miles an hour. It is stated that far higher speeds than this will ultimately be attained. The correspondent of *The Times*, who was present at the trial, was especially struck by the steady gliding movement of the start, in such marked contrast with the jerking on French railways. It reminded him of the English trains which are under way before the motion is felt. The Heilmann locomotive draws a closed tender containing a steam engine of the Pilon pattern, which works the dynamos. The motive power is transmitted directly to eight wheels about 3 ft. 5 in. in diameter.

While the application of electricity to the running of short and frequent trains for passenger traffic is regarded with growing favour, the economy of motor freight-cars is not so obvious, although every addition of goods to be carried as paying load increases the adhesion. For the distribution of mixed and small consignments within a limited area they would perhaps be suitable. But to deal with few and heavy goods trains* a single steam locomotive of large power would be more economical than electrical traction. In the latter case, the irregular distribution would demand a large capacity for the mains and for the generating stations, if several were provided; while, if only one station working at high tension is used, although its capacity need not be augmented, that of the transforming devices would have to be increased. Generally, therefore, for the economical working of goods, traffic steam is to be preferred.

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* *The Railway and Engineering Review*, Nov. 6, 1897.

† *Herapath's Railway Journal*, Nov. 19, 1897.

To other motive power it is scarcely necessary to allude. A horse may haul as little as 1½ tons on an ordinary road, or as much as 9 tons on rails, but in the case of the latter the road would have to be made up between the rails, so that the use of horses would generally be confined to shunting in station yards or to the movement of trucks on agricultural sidings. Cable traction is more particularly applicable to heavy and frequent traffic on steep and long gradients, the tractive power being independent of adhesion to the rails. It was at one time largely adopted in the United States for ordinary street tramways, but has been altogether displaced by electricity, and is practically outside the subject of light railways. Traction by compressed air motors or by gas engines is too exceptional to call for more than bare mention here.

Rolling-Stock.—Assuming that steam locomotives are to be employed on a light railway laid to standard gauge, it will probably be decided to build special engines and special passenger carriages. The cost of equipment and maintenance, however, will be reduced, and the convenience of through despatch from consigner to consignee will be secured by utilising the main line goods stock upon the light branch railway, as is done on the Wisbech and Upwell Tramway and other lines. Descriptions and illustrations of the special locomotives and passenger cars used on that line by the Great Eastern Railway Company are given in Chapter XV. It is sometimes claimed in favour of the adoption of a gauge different from the standard, that rolling-stock can then be built to suit the work it has to do, but that is merely a question of building separate stock, upon the standard or any other gauge.

The quantity of each kind of rolling-stock required will depend upon the description and amount of traffic—minerals, general merchandise, live stock, passengers, etc.,—to be dealt with, upon the service of trains, and upon their composition. In addition to engines actually running, we shall have some washing out, etc., in the engine sheds and others in the repairing shops. Of the latter, of course, there will be few at first, but, in course of time, we may have as

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* *Min. Proc. Inst. C.E.*, vol. cxxv., "The Substitution of Electricity for Steam in Railway Practice," by Louis Duncan. For. Abs.

STATISTICS OF ROLLING-STOCK ON CERTAIN RAILWAYS.

Details.	All Railways in England and Wales, Scotland, and Ireland.	Light Railways authorised under the Tramways (Ireland) Acts, 1860 to 1833.	Jodhpore-Bickaneer (metre gauge) Railway, India.	Dacca Section (metre gauge), Eastern Bengal State Railway, India.	Rajputana-Malwa (metre gauge) Railway, India.	Belgian Light Railways, 1895.
Number of miles of line open in 1896	21,277	230	364	86	1,784	867
Total number of locomotives	18,956	42	17	12	441	253
,, ,, passenger vehicles	58,983	127	69	67	1,316	716
,, ,, goods and other vehicles	633,771	469	232	259	7,412	1,780
Number per mile of line open of locomotives	0·891	0·183	0·047	0·140	*0·239	0·292
,, ,, passenger vehicles . .	2·772	0·552	0·190	0·780	*0·714	0·826
,, ,, goods and other vehicles .	29·787	2·039	0·637	3·012	*4·020	2·053
Value per mile of line open of engine stock	...	...	Rs.1,025	Rs.3,077	Rs.4,498	...
,, ,, coaching and goods stock. .	...	...	,, 1,707	,, 5,704	,, 7,524	...
Total value of rolling-stock per mile of line open	...	...	,, 2,732	,, 8,781	,,12,022	£633
,, ,, for each rupee earned per mile per week	...	...	,, 40·2	,, 76·4	,, 55·1	...
Gross earnings per mean mile worked per week	£81½	£4⅔	,, 68	,, 115	,, 218	...

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* Calculated on 1844 miles, including the Palanpur-Deesa, the Gaekwar's Mehsâna, and the Oodeypore-Chitor railways.

many as one-third of our total number out of running, or even 25 per cent. in the repairing shops and 25 per cent. in shed. In regard to coaching and goods vehicles, if we have to deal with a frequent service of trains, a rapid circulation of stock, and prompt unloading, reloading, and return of wagons, our stock will be less tied up and more fully utilised than if the traffic demands not more than one or two goods or mixed trains in each direction daily on a short line. If our traffic be mainly mineral, we shall have to be prepared with a considerable tonnage of special stock to carry such freight at low rates; for mixed goods of a higher class we shall have to provide a smaller quantity of suitable wagons. If we are fortunate enough to anticipate a long-lead traffic, less time relatively will be occupied in despatching and receiving than in actual running, and we shall require, therefore, less stock in proportion to our earning power. It will not always be safe to base our estimate upon an average demand, for we may have to deal with much heavier traffic at certain seasons—on market days, during fairs, etc.—and such an unequal distribution of service will oblige us to consider the maximum rather than the average. Where so many factors determine our requirements, it is useless to attempt to measure them in terms of one, but—as was observed in the chapter on Belgian Light Railways—we are not surprised to find that the gross earnings and the cost per mile of rolling-stock in the case of any railways which admit of comparison follow the same order. Thus, in the table on page 237 it will be noticed that the gross earnings per mile per week being Rs.68, Rs.115, and Rs.218, the total cost of rolling-stock per mile has been Rs.2732, Rs.8781, and Rs.12,022, on the Jodhpore-Bickaneer, on the Dacca section of the Eastern Bengal State Railway, and on the Rajputana-Malwa Railway respectively. The quantity of rolling-stock on the Belgian Light Railways depends less upon the demands of a considerable traffic than upon the restricted use of the stock upon a system of short sections. The conditions of traffic, however, vary so much, and the total effect of each of the different factors is so difficult to determine, that no useful rule or formula can be deduced from such figures, and the problem remains to be solved separately for any proposed line from a careful consideration of the probable traffic to be accommodated.

The provision of rolling-stock may not fall altogether upon the light railway. In the early days of railways the inconvenience of having to work with rolling-stock which was wanting in uniformity and did not comply with the regulations of the companies, induced the latter more and more to build their own stock: but in many cases it may be desirable for traders and agriculturists to place their own trucks and wagons upon the light railway.

For purposes of comparison the following table, containing a few of the standard dimensions and weights for rolling-stock in India, may be useful:—

STANDARD DIMENSIONS FOR LOCOMOTIVES AND ROLLING-STOCK IN INDIA.

			5 ft. 6 in. gauge.		Metre gauge.		2 ft. 6 in. gauge.	2 ft. gauge.
			A	B	A	B	...	...
	Maximum width of stock over all	ft. in.	10′ 6″	10′ 6″	8′ 6″	8′ 6″	7′ 6″	6′ 0″
	Maximum height above rail level	,,	13′ 6″	13′ 6″	11′ 0″	11′ 0″	10′ 0″	9′ 0″
	Minimum width of seat per passenger	inches.	19½	19½	19½	19½	19½	19½
	Minimum floor area per passenger	sq. ft.	3½	3½	3½	3½	3½	3½
	Minimum cubic capacity per passenger	cub. ft.	25	25	25	25	22	22
	Maximum rigid wheel base for passenger vehicles	feet.	22	16	15	12	12	10
	Maximum rigid wheel base for goods vehicles	,,	16	14	12	10		
With engine in working order, and full load of fuel and water and with vehicles fully load'd.	Maximum weight on a pair of wheels for locomotives	tons.	15	15	8	8	6	6
	Maximum weight on a pair of wheels for goods stock	,,	12	12	7	7	4	4
	Maximum weight on a pair of wheels for coaching stock	,,	9	9	5	5		
	Maximum weight per foot run of wheel base for tank engines	,,	4	4	2·67	2·67	...	...
	Maximum weight per foot run of wheel base for engine and for its tender separately	,,	3	3	2·00	2·00	...	...
	Maximum weight per foot run over buffers for tank engines	,,	1·875	1·875	1·333	1·333	...	...
	Maximum weight per foot run over buffers for engine and its tender together	,,	1·625	1·625	1·125	1·125	...	...
	Maximum weight per foot run over buffers for goods stock	,,	1·200	1·200	0·800	0·800	...	...
	Maximum total gross weight for tank engine	,,	...	60	...	32	...	...
	Maximum total gross weight for engine and tender together	,,	...	86	...	46	...	...
	Standard diameter on the tread for all new carriage or wagon wheels	ft. in.	3′ 7″	3′ 7″	2′ 4″	2′ 4″	...	...

A. Absolute for any railway for all new works. B. Recommended for all except unimportant branches.

The figures are given for the 5 ft. 6 in., the metre, and special (2 ft. 6 in. and 2 ft.) gauges. Three times the gauge may be regarded as the maximum width of stock over all, and this is permitted in the case of the 2 ft. 6 in. and 2 ft. gauges. If the weight in lbs. per yard of rail were equal to six times the greatest load on a pair of wheels, we ought to have a 90 lb. rail on the 5 ft. 6 in. gauge, a 48 lb. on the metre, and a 36 lb. rail on the special gauges ; but, in each case, if we reduce the axle-load or reduce the speed, we may use a lighter rail. For example, our 62 lb. rails, which still carry ordinary trains on the 5 ft. 6 in. gauge at normal speed, are amply strong for light railways on the same gauge, after years of service in the main line, and we may place upon them trains of ordinary goods and coaching vehicles from the main line, hauled by the lighter locomotives, at speeds of 15 to 20 miles an hour.

The annual (now biennial) meetings of the Locomotive and Carriage and Wagon Superintendents in India have brought them more and more into agreement in regard to the importance and economy of uniformity in the design of rolling-stock, and the following table exhibits the principal dimensions which they recommend for adoption on the 5 ft. 6 in. and metre gauges :—

INDIAN RAILWAYS.

Standard Designs of Rolling-Stock, approved by the Committee of Locomotive and Carriage Superintendents.

	5′ 6″.	Metre.
Coaching Stock—		
Figured width over sunshade board, . .	10′ 6″	8′ 6″
*Width outside body, ...	9′ 0″	7′ 9″
Height inside, ...	7′ 9″	not less than 7′ 0″
Height from rail to top of lamp cover, . .	13′ 3″	11′ 0″
Wheels, diameter of (as scaled), ...	3′ 7″	2′ 3″
Height of buffer centres, ...	3′ 7½″	1′ 11″
Length of under-frames, ...	27′ 0″	19′ 4″
,, ,, ,, (bogie) . . .	...	40′ 0″
Goods Stock—		
Width outside angle-irons, ...	9′ 4¾″	...
,, inside sheeting, ...	9′ 0″	...
Height inside, ...	7′ 10½″	7′ 0″
Height from rail to top of roof, ...	12′ 0″	...
Width outside sheeting, ...	...	7′ 0″
Wheels, diameter of body of, ...	3′ 2″	2′ 0″

* Compare English passenger-carriages, which may be 7 ft. 6 in. wide inside, and American cars 9 ft. or more, both on the 4 ft. 8½ in. gauge.

On light railways of short length, tank engines, carrying their own coal and water, will enable us to do without separate tenders. Unless the haulage is heavy enough to require the coupling of six wheels, and more especially if the curves are so sharp as to make it necessary to limit the length of rigid wheel-base as much as possible, a four-wheels-coupled engine will be best, with a leading bogie or one free radial axle to steady it, and prevent that galloping action which short-based four-wheeled vehicles, running at fair speed, inflict upon the track and the passengers. If the light railway runs on a high road or through the streets of a town, it may be necessary to case it in, so that the working parts may be covered and fire concealed from view. It is often convenient to be able to work the engine from either end —the driver standing upon whichever platform happens to be in front—and the driver should not only be able to move freely from one part of his engine to another, but foot-boards and hand-rails should be provided on every vehicle, so that there may be easy communication between the driver and the guard or conductor, from one end of the train to the other. Outside-cylinder engines are generally adopted, and the swaying action on lines of narrow gauge is considerably lessened by placing the frames outside the wheels.

It is not possible here, nor is the writer qualified, to enter into details regarding the design of locomotives to suit many and varying requirements and conditions. The great locomotive firms will furnish designs in accordance with any given specification. But it may not be out of place to give a few facts regarding locomotives.

Speaking roughly, the resistance of trains may be as low as 12 lbs. per ton of weight of train at a velocity of 20 miles an hour, and more than 50 lbs. per ton at 60 miles an hour. On a gradient there is an additional resistance—in pounds per ton of train—equal to $\frac{2240}{G}$, if $\frac{1}{G}$ be the rate of gradient. The resistance is also considerably increased by head winds, side winds, curves, or roughness of road; in the case of curves, it will be affected by the length of wheel-base.

The adhesive force of locomotives per ton of load on the driving wheels, and on all wheels coupled to the driving wheels, is estimated at 450 lbs. in ordinary English weather; it may be as high as 600 lbs. on very dry rails, or as low as 200 lbs. in frosty weather.

If D = diameter of cylinder in inches,
P = mean pressure of steam in cylinders in lbs. per sq. in.,
L = length of stroke in inches,
W = diameter of driving wheel in inches,
T = tractive power on rails in lbs.,

the following formula is given by Molesworth* to determine the tractive force:—

$$T = \frac{D^2PL}{W}$$

---

* *Molesworth's Pocket Book.*

If R^g = resistance due to gravity on the steepest gradient in lbs. per ton (see above),
R^r = resistance due to assumed velocity of train in lbs. per ton,
T = tractive power of engine in lbs. as found above,
W = weight of engine and tender in tons,
L = load the engine can take in tons, including the weight of the wagons, but not that of engine and tender,

we have the following formula for finding the load which an engine will take on a given incline:—

$$L = \frac{T}{R^g + R^r} - W$$

If S = square feet of heating surface, and V = velocity in miles per hour, then T, the tractive force in lbs. that may be developed in a locomotive $= 374 \frac{S}{V}$.

If D = diameter of cylinder in inches, the length of stroke may be about $1\frac{1}{2}D$, and the capacity of tanks of tank-engines in gallons may be about $60D$. In French practice, H, the heating surface is determined by the formula $A = \cdot 00136H$, where A = area of one cylinder; and the area of fire-grate $= \cdot 013H$.

The quotation of these formulæ will, at any rate, give the ordinary reader some idea of the relative effect of the various dimensions which are given when describing locomotives. It is obvious, for example, that—if we are satisfied with low speeds—we may increase the tractive power by decreasing the diameter of the driving wheels; that, if we increase the tractive power by increasing the diameter of the cylinder and the length of the stroke, we must also increase the heating surface and the area of the fire-grate; and that we can haul heavier loads at low speeds.

If the adoption of a narrower gauge deprives us of the use of the main-line stock and forces us to build our own goods wagons, we shall probably find four-wheel wagons most economical for a mixed traffic of comparatively small consignments. A low ratio of dead to paying load and a maximum capacity of wagon space are important in dealing with a long-lead carriage of a few staple commodities in full loads, and, for such, bogie stock, which are not generally suitable for pick-up traffic on short lines, may be preferred. Our wagon stock should consist of as few types as possible. Most of our goods trains have no brakes which can be got at and applied or taken off while the train is in motion, except those on the engine and van, and the concentration of stopping power in the latter adds considerably to the non-paying load to be hauled. The question of adopting some arrangement by which hand brakes on the loaded vehicles may be operated by the guard deserves consideration. In India, and in tropical climates generally, the goods stock should be of iron, not wood.

With passenger vehicles through communication from one end of the train to the other may be secured by a central longitudinal aisle dividing the transverse or longitudinal seats with foot-plates covering the buffers and couplings, or else by foot-boards and hand-rails on the outside of the cars. We may arrange the seats transversely, if preferred, but it will not be necessary, as in ordinary carriages, to carry cross partitions right up to the roof. Indeed, the carriage may also, in a fine climate, be open at the sides, with awnings or tarpaulins which may be let down as a protection against sun or rain. When the sides are closed in, and a longitudinal aisle is provided, the ends and intermediate partitions should have sliding doors, and a verandah and steps at each end of the carriage, so that passengers may conveniently enter and alight. Both these types are adopted in India and on light railways on the Continent. The passenger stock can be more fully and economically utilised if accommodation is restricted to only one, or, at the most, two classes of passengers. The provision of three classes of compartments and of special smoking compartments of all three classes, and the reservation of compartments for ladies only, make it impossible to fill the carriages on the main lines uniformly, and increases the amount of dead weight hauled. If old main-line stock is available, we may be able to adapt it to light-railway purposes by removing the partitions, closing the side doors, and adding end doors opening on to end platforms and verandahs. It appears to be usual on the Continent to allow the latter to be occupied by passengers as standing places. The Western Railway of France has started "tram-trains," consisting of two-axled vehicles containing 75 passengers and luggage, on light lines forming part of its system; and four-wheeled cars of this kind with short wheel-bases may very well be used where the speeds are low.

The rolling-stock in use on Belgian Light Railways has been briefly referred to in Chapter III., and the quantity and cost of different types have been given. The engines manufactured by the Société St. Leonard at Liége for these metre-gauge lines* are, as previously stated, outside-cylinder six-wheels-coupled engines, with frames outside the wheels to reduce the side sway. As the engine has so short a total wheel-base—over leading, centre, and trailing wheels—as 5 ft. 10⅞ in., the end overhang is considerable. The engine is cased in, as it is advisable to cover up the fire and working parts of locomotives plying on ordinary roads. The main connecting rods are very long, as they are directly coupled to the crank pins of the rear axle on Hall's system, in order to reduce the leverage of the overhang of the crank pins by bringing the coupling rods closer to the wheels. The centre of gravity is kept low, and the weight is distributed as uniformly as possible over the coupled axles by means of compensation levers. The grate is built for burning coal-dust briquettes. The boiler is fed by Giffard injectors from water tanks on both sides. The price of the engine is stated to be about 11·32d. per pound of weight. The following are the principal dimensions:—

---

* *The Engineer*, May 1, 1896.

Diameter of cylinders,	11 in.
Stroke of pistons,	1 ft. $2\frac{1}{8}$ in.
Diameter of wheels,	2 ft. $8\frac{3}{4}$ in.
Wheel-base,	5 ft. $10\frac{7}{8}$ in.
Length of fire-box,	3 ft. $4\frac{7}{16}$ in.
Width of fire-box at top,	3 ft. $0\frac{3}{4}$ in.
Width of fire-box at bottom,	2 ft. $3\frac{11}{16}$ in.
Height of fire-box in front,	3 ft. $7\frac{5}{16}$ in.
Height of fire-box at end,	3 ft. 1 in.
Diameter of barrel,	3 ft. $4\frac{9}{16}$ in.
Total length of boiler,	10 ft. $4\frac{7}{8}$ in.
Length of tubes between tube-plates,	5 ft. $2\frac{3}{4}$ in.
Diameter of tubes,	$1\frac{3}{8}$ in. to $1\frac{9}{16}$ in.
Number of tubes,	160.
Grate surface,	7·9 sq. ft.
Heating surface of fire-box,	44·65 sq. ft.
Heating surface of tubes, inside,	299·12 sq. ft.
Total heating surface,	343·78 sq. ft.
Capacity of water tanks,	444·4 gallons.
Capacity of coal bunkers,	1100 lbs.
Weight of engine, empty,	15 tons, French.
Weight of engine in full working order,	$18\frac{1}{2}$ tons, French.
Certified boiler pressure,	10 atmospheres.
Theoretical tractive power,	7700 lbs.
Effective tractive power at 60 per cent.,	4620 lbs.
Total length of engine to end of buffers,	20 ft. $2\frac{7}{8}$ in.
Outside width,	8 ft. $0\frac{3}{4}$ in.
Height from rail surface to top of chimney,	9 ft. $11\frac{7}{16}$ in.

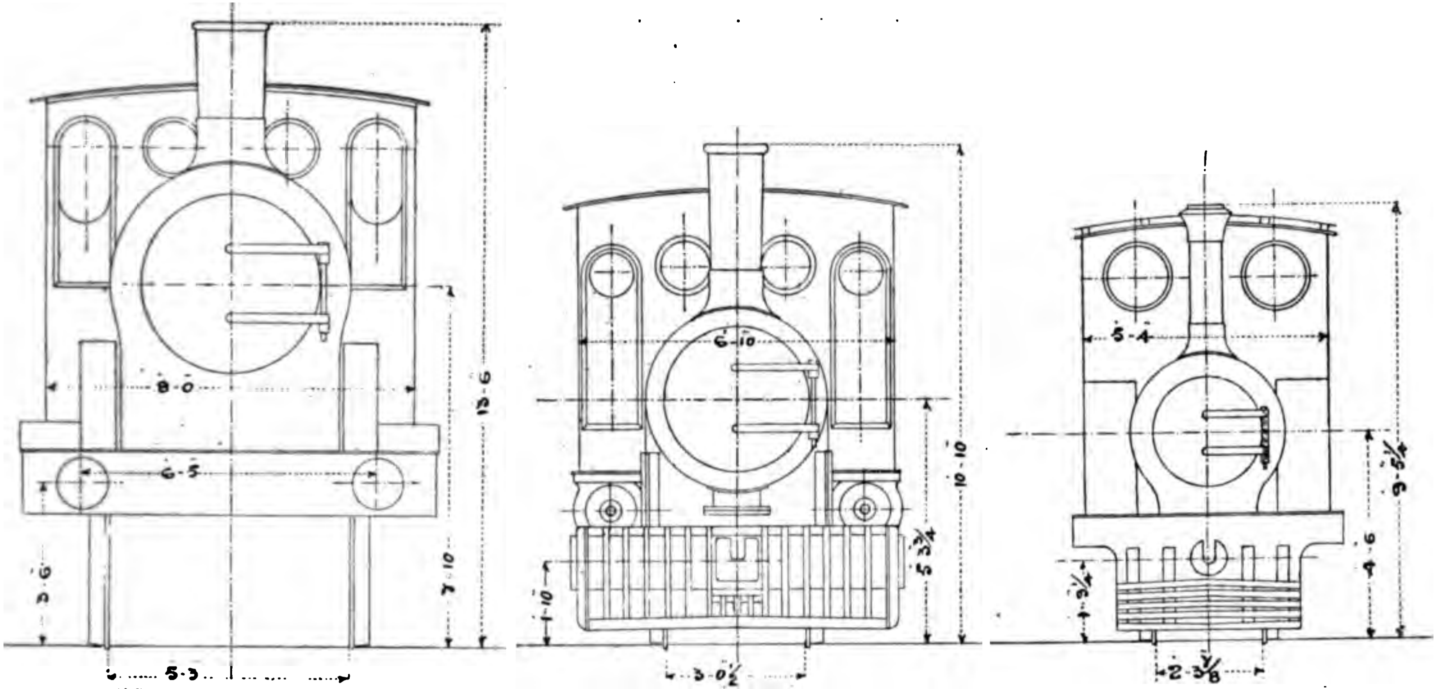
Engines of similar type are also constructed by the Société Métallurgique of Brussels, the company which supplies most of the vehicles. These have a length over buffers of 23 ft. $10\frac{9}{16}$ in., and an outside width—exclusive of roof—of 7 ft. $7\frac{1}{4}$ in. The second-class cars have plain boarded cross-benches to seat twenty-four inside, and afford standing room for sixteen more passengers on the two platforms. In the first-class the seats are cushioned, and in some compartments are arranged longitudinally on one side of the aisle, so that they may also be used as couches. Both classes of cars have a longitudinal aisle (leaving seats for two on the transverse benches on one side, and for one on the other) and iron flaps covering the buffers and couplings, so that the conductor can pass from end to end of the train. Some of the cars are open at the sides, in which case end platforms are not provided. All the cars are four-wheeled, with a wheel-base of 7 ft. $10\frac{7}{16}$ in. Other dimensions and the cost have already been mentioned in Chapter III.

The same writer in *The Engineer*—observing in the first place that the arrangement of two or more coupled axles, and a costly movable bogie with two free axles either in front or at the tail of the engine, is not altogether satisfactory on light railways, where tractive power is so much more important than speed, because the bogie absorbs so much of the weight of the engine, and, secondly, that locomotives fitted with one radial axle are not completely successful in adapting themselves to sharp curves, because they do not readily return to their normal position—draws attention to the system patented by Krauss & Co. of Münich for forming the bogie out of one of the coupled axles, and of one free axle only. In spite of their comparative lightness, these locomotives are said to take sharp curves steadily and easily without slacking speed, and to be largely used on main, secondary, and light railways.

Reference has been made in Chapter IV. to the rolling-stock in use on a French light railway—from Caen to Dives and Luc-sur-Mer—constructed and equipped by the well-known Decauville Company. This line is a portable railway on the 2 ft. gauge, and is an interesting example of the capacity of such stock. All the passenger and most of the goods vehicles are mounted on bogies. A third-class carriage, weighing 3½ tons, will carry fifty-six passengers. A bogie wagon, weighing 3¼ tons, will carry a standard-gauge load of 10 tons. Full descriptions, giving details of weight, capacity, price, etc., with illustrations of rolling-stock as required for portable railways of 2 ft. 6 in., 2 ft., and narrower gauges, will be found in the lists of the Decauville Company and of Messrs John Fowler & Co.

Having briefly reviewed the metre-gauge rolling-stock on Belgian Light Railways, and the 2 ft. rolling-stock on a French "Decauville" line, reference is to be made to Chapter XV. for a description of the 4 ft. 8½ in. rolling-stock on the Wisbech and Upwell Tramway, and then it may be worth while to compare rolling-stock of three different gauges—the 5 ft. 6 in., the metre, and the 2 ft. 6 in.—all in use on one system, the Eastern Bengal State Railway. The physical difficulties in one part of the country and the other do not greatly differ, but, as the system is divided into sections by wide and shifting rivers which compel transhipment in any case, the principal objection to a change of gauge must in any case be reckoned with, and narrower gauges have been adopted where the traffic did not require lines of wider gauge and greater capacity. The design of narrow-gauge stock appears sometimes to be so strained and forced by the concentration and increase of axle-loads which demand stronger, heavier, and more expensive permanent-way and bridging, that at last the claim of the line to be called a light railway depends mainly upon the narrowness of the gauge. Here, however, we have a very fair comparison of the differences which follow the adoption of one gauge or another under normal conditions.

The locomotives illustrated in fig. 4 on page 246 and in Plate V. are the D class four-wheels-coupled engine on the 5 ft. 6 in. gauge, the F class six-wheels-coupled engine on the metre gauge, and the



"D" Class. 5 ft. 6 in. Gauge.

"F" Class. Metre Gauge.

2 ft. 6 in. Gauge Engine.

FIG. 4.—Front Elevations of Engines on the E.B.S.R.

four-wheels-coupled tank engine on the 2 ft. 6 in. gauge. In addition to the details on the diagrams, the following dimensions may be quoted:—

		5 ft. 6 in.	Metre.	2 ft. 6 in.
Cylinders, diameter,	in.	18	14	8½
„ Stroke,	in.	26	20	12
Heating surface, tubes,	sq. ft.	1157·61	590	210
„ „ Fire-box,	„ „	124·49	59	29
„ „ Total,	„ „	1282·10	649	239
Fire-grate area,	„ „	22·04	12	5·18
Capacity, coal,	cub. ft.	235	120	20
„ water,	gallons	2500	1000	400

The third-class carriage (Plate VI.) on the 5 ft. 6 in. gauge seats 60, on the metre gauge 32, and on the 2 ft. 6 in. gauge 32 passengers.

The tare, load, and cubic capacity of the wagons (Plate VI.) are as follows:—

		5 ft. 6 in.	Metre.	2 ft. 6 in.
		T. cwt. qr.	T. cwt. qr.	T. cwt. qr.
Covered goods wagon	Tare,	8 0 0	4 17 0	3 9 0
	Load,	16 0 0	9 3 0	3 13 1
Low-sided wagon	Tare,	6 14 0	2 18 0	2 3 0
	Load,	11 6 0	5 19 0	4 19 3
		c. ft.	c. ft.	c. ft.
Covered goods wagon, cub. capacity,		1300·60	870·50	583·28
Low-sided wagon, „ „		327·25	138·18	118·59

A brief description may now be given of the rolling-stock specially designed and constructed for the 2 ft. 6 in. gauge Barsi Light Railway in India.

Thanks to the courtesy of Messrs Kitson & Co., Leeds, and of the Leeds Forge Co., the writer was able to inspect the Barsi Light

Railway stock exhibited at Newlay in October 1896, and the diagrams are here shown (Plate VII.) by permission of the consulting engineer, Mr Everard R. Calthrop, who has had valuable experience of Indian requirements, and whose name is well known in connection with the light-railway question generally.

In the year 1870, the Government of Bombay constructed a road—with earth-works, cuttings, and bridges—from Barsi Road Station, on the Great Indian Peninsular Railway, to Barsi, a distance of 22 miles. The bridges were supposed to be built of sufficient strength to carry locomotives, but the engine about to be described had not then been designed, the gradients did not exceed 1 in 100, the curves were easy, and the embankments have, of course, been thoroughly consolidated in the course of years. In 1895, a company obtained from the Secretary of State a concession to construct a light railway on the road (to Barsi, and since beyond), and this stock has been designed and constructed for it.

A rail weighing 35 lbs. per yard has been adopted, and the maximum axle-load fixed at 5 tons. Mr Calthrop gives the following details of train-loads :—

	Tons.	Cwt.
Max. weight of engine in working order, .	29	8
Train load on gradient of 1 in 100, . .	260	0
Actual tare weight of wagon, . . .	4	2
Max. load-limit per wagon, . . .	15	8
Max. weight of goods hauled, . . .	190	16, or 73% of train.
Min. dead-weight of train, . . .	69	4, or 27% of train.
Composition of train, ...	12 wagons and 1 brake.	

Mr Calthrop lays great stress on "the necessity of uniformity of axle-loads for engines, carriages, and wagons on light railways of narrow gauge, when the prime object is the reduction of the weight and cost of the track to the lowest possible figure compatible with economy"; accordingly, the rolling-stock, including locomotives, has been designed on the principle of fully utilising a maximum uniform load of 5 tons per axle, to run on rails of a minimum weight of 30 lbs. per yard, at a speed not exceeding, under ordinary circumstances, 15 miles per hour. The maximum moving dimensions of this rolling-stock are as follows :—

	Ft.	In.
Height at centre, ...	10	0 from rails
Height at sides, ...	9	0 ,, ,,
Width, ...	7	6

The locomotives (Plate VII. fig. 2) are tank-engines of the "consolidation" type, having 8 coupled wheels, 2 ft. 6 in. in diameter, bearing 19¾ tons on a coupled wheel-base of only 8 ft. 3 in., and a trailing bogie. All the wheels, coupled and trailing, are steam-braked. The total weight of the engine, fully loaded up, in working order, is

29 tons 8 cwt. The valve gear is of the Walschert type. The engine has an extended smoke box. The following details may be quoted:—

Capacity	Water,	800 gallons.
	Fuel,	80 c. ft.
Cylinders, diameter,		13 inches.
,, stroke,		18 inches.
Heating surface, tubes,		484 sq. ft.
,, ,, Fire-box,		44 sq. ft.
,, ,, Total,		528 sq. ft.
Fire-grate area,		8¾ sq. ft.
Tubes, 110,		1¾ in. diam. outs.

The haulage power of this locomotive was calculated on a basis of a train-load, exclusive of engine, of 151 tons taken up a gradient of 1 in 57, at 1036 tons[*] on the level and straight, and at 276 tons on the proposed ruling gradient of 1 in 100 on a curve of 600 ft. radius. As a matter of actual performance at Newlay the engine hauled 190 tons up the gradient of 1 in 57, so that the theoretical figures have been favourably under-estimated.

For purposes of comparison it may be mentioned that the Cooch Behar State Railway locomotives, on the same gauge, have a grate area of 5·18 sq. ft., and cylinders 8½ in. diam. by 12 in. stroke; carry 400 gallons of water and 20 c. ft. of fuel (about half a ton of coal, for example); have six wheels coupled on a base of 8 ft. 6 in.; and were required to haul only 275 tons on the level. The axle-loads on the coupled wheels amount to 13 tons 4 cwts. 3 qrs. on a wheel-base of 8 ft. 6 in., as compared with 19 tons 15 cwts. on a wheel-base of only 8 ft. 3 in. on the Barsi Light Railway. The Cooch Behar State Railway was designed for less work and lighter rails and bridges, the weight of the rails being only 25 lbs. per yard.

To combine the maximum haulage power with a uniform axle-load of 5 tons has been the leading motive in the design of the Barsi engines. It is scarcely correct to say that this has saved the weight of the rail, for that does not depend only on the maximum axle-load on any *one* pair of wheels; and it has been accomplished by the concentration of a greater weight within a shorter base, which has made it necessary to strengthen or replace the bridges.

In designing the wagons the object has been to combine the maximum carrying capacity with the minimum tare weight. Of the wagons (Plate VII. figs. 3, 4, 5) there are three patterns—the covered goods wagon, the high-sided coal wagon, and the low-sided or platform goods wagon. In accordance with Mr Calthrop's principle—which our locomotive superintendents in India now generally recognise—identity and interchangeability of parts and uniformity in dimensions, wherever possible, are regarded as essential. The following details are common to the three kinds of goods stock :—

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[*] *Engineering*, October 30, 1896.

	Ft.	In.
Length over head-stocks, ...	25	0
Width, ...	7	0
Length over buffers, ...	28	3
Distance between centres of bogies, . .	16	8
Wheel-base of bogies, ...	4	3
Total weight on rails, fully loaded, . .	20 tons.	

All three sorts of wagons are of the bogie type, and built throughout of Fox's pressed steel. The makers claim that, although wagon and bogie frames of pressed steel might cost £6 5s. per ton, as against £5 15s. for channel steel, they are lighter by about 15 per cent. on bogies and 10 per cent. on frames, they consist of fewer separate pieces, and they require fewer knees and less riveting; they suffer, therefore, less from vibration and corrosion, and accordingly last longer. On the other hand, it appears to the writer that repairs and renewals of parts can be more easily effected on built-up frames. Of the two types of bogies the non-bolster type would seem to be quite good enough for 2 ft. 6 in. gauge stock; its weight is made up as follows :—

	Cwt.	Qrs.	Lbs.
Weight of bogie, ...	8	3	0
„ „ wheels and axles, . .	12	2	0
„ „ brake, ...	1	0	10
	22	1	10

The swing-bolster type weighs, with brakework as above, 25 cwts. 2 qrs. 10 lbs. The wheels have a diameter, on their tread, of 1 ft. 11 in. The high-sided wagon has a capacity of 1000 c. ft. All are fitted with a hand brake which can be applied or taken off from either side of the vehicle; the brake is applied to one bogie only.

The length of the composite passenger car (Plate VII. fig. 6) is 43 ft. 3 in. over buffers, and 40 ft. over head-stocks. The distance between centres of bogies is 28 ft. The bogies and under-frames are of pressed steel. The body of the car was made by the Lancaster Railway Carriage and Wagon Company; is 40 ft. 6 in. long, and 7 ft. 6 in. wide over the sunshades, with a clear width of 6 ft. 2 in. inside; and is divided into luggage and brake compartment, an upper-class compartment with sleeping-berths and lavatory, and a lower-class compartment with transverse seats. The end platform and centre gangway pattern has not been adopted, nor did the writer see carriages with open sides and awnings or tarpaulins hung as required, such as are frequently used on narrow-gauge lines in India and on the Continent. Sunshades are absolutely necessary in a country like India. There is a brake on each bogie, one worked directly by the hand wheel in the compartment, the other indirectly, but with equal effect, through a pull-bar connection. The over-hang is such that, on the 2 ft. 6 in. gauge, we have here coaching stock 6 ft. 8 in. wide over pillars, as compared with a width of 8 ft. 0 in. on the standard 4 ft. 8½ in. gauge; the height, too, is ample, being 10 ft. from rail level at the centre, and 9 ft. at the sides. A flexible buffer coupling has been adopted, permitting a radial movement through an angle of 36 degrees, so that the stock can be admitted to sidings on curves with the maximum radius of 150 feet.

The line at the Newlay Exhibition of Barsi Light Railway stock in October 1896 was laid with 30 and 35 lb. Vignoles rails on steel sleepers, supplied by the Moss Bay Hæmatite Steel and Iron Co., Workington. A diagram of the trial train is shown in Plate VII. fig. 1. The wagons and cars took the 150 ft. radius curves without difficulty, while the engine was able to manage curves of 250 ft. radius nominally, but in places much sharper, measurements made by the writer indicating radii of 190 and 210 ft. at two points chosen at random. An actual load of 190 tons* was taken up a gradient of 1 in 57. There is no doubt, therefore, that the engine can work the train-load of 260 tons on the ruling gradient of the Barsi Light Railway as required; a load which would, on a passenger train, provide accommodation for 30 upper-class and 736 lower-class passengers, while, with 12 goods wagons and a brake van, its capacity would be equal to 190¾ tons of goods and 38 passengers. Mr Calthrop mentions this in support of his contention that the 2 ft. 6 in. gauge "possesses the greatest carrying capacity per cent. of capital cost."

In actual use in India, the usual train-load is one lower-class carriage and one composite brake, with nine loaded goods wagons, making up a gross load of about 210 tons.

The consumption of water is about 30 gallons, and of coal about 4·1 lbs. per mile per vehicle (including the engine).

The cost of the rolling-stock delivered at Bombay (taking the rupee at 15d.) was as follows:—

	Rs.	£
Engine,	32,160	2010
Saloon car,	19,420	1214
Composite brake van,	17,480	1092
Lower-class car,	15,380	961
Low-sided wagon,	2,040	127
High-sided wagon,	2,680	168
Covered goods wagon,	2,640	165

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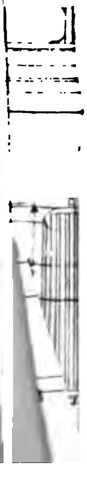
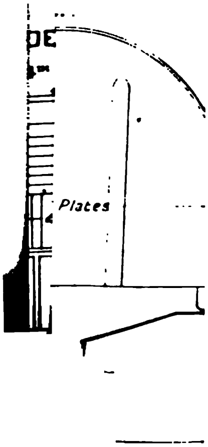
* *Engineering*, October 30, 1896.

The cost of this 2 ft. 6 in. gauge locomotive, therefore, is greater than that of an ordinary F class metre-gauge engine. Its tractive power is about the same. Its wheels are smaller, and it has a greater ratio of length of stroke to diameter of wheel, and is only suited, therefore, to run at a much lower speed. It brings nearly as much adhesion weight on a shorter wheel-base, 19¾ tons on 8 ft. 3 in., and, the axles being so close together, a heavier load on each sleeper.

re Gauge.




Plates

CHAPTER XV.

LIGHT RAILWAYS IN ENGLAND, SCOTLAND, AND WALES.

CONTENTS.—Corris, Easingwold, Festiniog, Glyn Valley, North Wales, and Southwold lines—Other lines—Wisbech and Upwell Tramway—Three Horse-Shoes and Benwick Goods Line—Easingwold Railway—Proceedings of the Light Railways Commissioners and Board of Trade under the Act of 1896—Applications made in December 1896—And in May 1897—Echt Extension—Motive power—Derby and Ashbourne—Lizard—Pewsey and Salisbury — Lincolnshire and Northamptonshire—Light Railways approved during 1898.

Light Railways in England and Wales.—Details of the cost and working of half-a-dozen light railways in England are quoted below from the *Railway Returns*, 1896, and it must be confessed that if the record of the past were not likely to be beaten in the future, the prospects of light-railway enterprise would be bad indeed.

The Easingwold Railway is a 4 ft. 8½ in. line, 2 miles 37 chains long. It has cost nearly £17,000, of which £1267 was for Parliamentary and legal expenses and £2300 for land. Had the Light Railways Act of 1896 been in existence, the costly procedure which is accountable for the first item would have been avoided, and advantage would have been taken of the arbitration clauses of the new Act to obtain the land at much less cost. The Easingwold Railway would also have been exempted from the payment of passenger duty. In order to make both ends meet, they can only afford to take third-class passengers by the statutory Parliamentary trains night and morning, and they have to pay passenger duty on all other receipts. It seems to the writer that the Act should be retro-active, and that lines like the Easingwold should, as far as possible, be admitted to its benefits. Of such burdens as Parliamentary expenses and cost incurred for land it cannot now, of course, be relieved; these must be borne for ever. The Southwold line appears to be similarly handicapped.

The Corris Railway is the only one of these half-dozen which has been built at anything like the small cost looked for on light railways. Its gauge is 2 ft. 3 in.

The Festiniog Railway, although of only 2 ft. gauge, has cost more

STATISTICS OF LIGHT RAILWAYS IN ENGLAND (*Railway Returns*, 1896).

Name of Company.	Capital.	Mileage open in 1896.	Passenger Traffic.	Goods Traffic.		Gross Receipts.		Total Receipts.	Working Expenditure.	Net Receipts.	Proportion per cent. of Expenditure to Receipts.	Rolling-Stock.		
			[b] Passengers.	Minerals.	General Merchandise.	Passengers.	Goods.					Locomotives.	Passenger.	Other.
	£		No.	Tons.	Tons.	£	£	£	£	£				
Corris, . . .	20,000	11	76,207	16,048	2,424	1,437	2,226	4,027	2,796	1,231	69	3	7	18
Easingwold, . .	15,784	2	36,985	6,211	8,335	726	873	1,636	969	667	59	1	2	...
Festiniog, . .	150,186	[a] 14	171,464	132,494	13,916	7,252	11,740	19,326	11,485	7,841	59	9	60	1,250
Glyn Valley Tramway,	59,243	9	25,493	41,582	778	594	2,842	3,509	2,295	1,214	65	3	12	238
North Wales (narrow gauge),	126,405	12	52,795	21,626	1,271	2,452	2,487	4,991	4,287	704	86	3	16	145
Southwold, . .	76,536	9	85,303	6,611	5,343	2,581	1,303	4,140	3,484	656	84	3	6	26

[a] Of which two miles are double.

[b] Exclusive of season and periodical tickets.

than £10,000 per mile. The earth-works were heavy, the rail weighs as much as 50 lbs. per yard, a very busy traffic—both passenger and mineral, mainly in connection with the slate quarries—has justified a considerable expenditure on rolling-stock, and the works include a tunnel nearly half a mile long. It is a line that pays well, but it is not to be taken as an example of an average light railway, its conditions being exceptionally favourable.

Of the others, the Southwold has a gauge of 3 ft., the North Wales 2 ft., and the Glyn Valley 2 ft. 4½ in.

There are other light lines, not included in the *Railway Returns*, such as the Wantage Tramway (Great Western Railway) and the Wisbech and Upwell Tramway (Great Eastern Railway), both of which take the main-line trucks, but have special passenger carriages of the tramcar pattern, and run partly—the Wisbech and Upwell almost entirely—along the public road. There are also several special narrow-gauge lines like that on Mr Pike's property, which runs from the china clay mines to Poole and carries no passengers. Instead, however, of giving details of a number of railways, it seemed to the writer that a particular description of three standard-gauge light lines visited—a tramway (Wisbech and Upwell), a light goods line (Three Horse-Shoes and Benwick), and a railway (Easingwold)—would be more interesting and more useful than a mere collection of facts and figures.

The Wisbech and Upwell Tramway, G.E.R.—One reason why the Tramways Act of 1870 [33 and 34 Vict. cap. 78] has failed to meet the case of such light lines as we are discussing is that it does not satisfactorily provide for the carriage of goods. When, however, a company like the Great Eastern Railway—under special Acts of 1881–82, confirming the Provisional Orders relating to tramways—constructed the Wisbech and Upwell line, this objection was practically removed: (1) because the tramway made physical junction with the rails of the main line on the same gauge; (2) because the design of the permanent-way not only satisfied the road authorities, but was such also as permitted main-line goods stock to pass over the tramway; and (3) because the railway company could, at a minimum expense, make all necessary arrangements for collecting, loading, through booking and delivery of goods, and for other services.

The tramway runs out from the Wisbech Station on the Great Eastern Railway—through Elm Bridge, Boyce's Bridge, Outwell Basin, and Outwell village—to Upwell, a distance of 5¾ miles. The total length of tramway open for public conveyance of passengers is 7 miles 64 chains,* or 7·8 miles; and the capital expenditure was £41,926, or £5375 per mile of tram laid. Of the total expenditure, £31,425 was on account of way and works, £7000 for locomotive engines, £2485 for cars, and £1016 for legal and Parliamentary expenses.

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* *Tramways Return* for the year ending June 30, 1896.

The line is laid mainly on one side of the public road, and parallel to the canal, which it crosses three times.

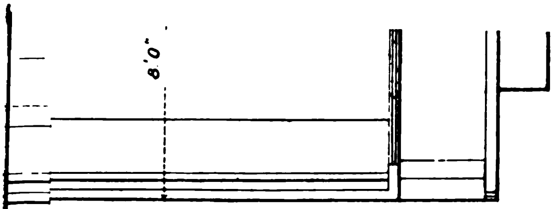
From the Wisbech home signal the track changes to a 50 lb. flat-footed steel rail (Plate VIII. fig. 1) resting on a flat cast-iron chair or bearing-plate, through which it is fastened to a transverse sleeper of creosoted pine, measuring 9 ft. by 10 in. by 5 in., by means of a compressed oak trenail and a wrought-iron dog-spike. The sleepers are spaced 3 ft. apart, centre to centre, and packed in gravel ballast. To the Vignoles rail a light 24 lb. wrought-iron guard rail is fastened by ¾ inch wrought-iron bolts passing through cast-iron distance pieces—leaving a clearance of 1½ inch—at intervals of 18 inches. This arrangement was adopted as a substitute for the ordinary tram rail. Like the latter, it would permit the track to be paved with granite setts — as was then intended — in the four-foot as well as outside the rails; but it differed from the tram rail in that it could carry railway stock running entirely on the tread, and not on the flange of the wheel. So much less objectionable, however, did the line look, when actually laid, than the road authorities had expected —so much more formidable are working drawings, especially sections, than the top view of the finished track—that the railway company was not called upon to incur the expense of paving except at level-crossings, as where, for example, the tramway curves across a public road just as it emerges from Wisbech Station. The road authorities were lenient, and not only the cost of paving or consolidating the road up to the same level as the rest, and so maintaining it, could be saved in such a case, but also the guard rail, distance pieces, and bolts, which are obviously superfluous. The quantities and weights of materials are given in the statement on page 257.

In regard to points and crossings, it may be observed that the switch and stock rail are fastened by means of a bolt passing through them, a cotter, and a padlock, the key of the latter being in charge of the goods porter at the stopping-place.

As is usual on tramways, the trains on this line stop to pick up and set down passengers at any point by the wayside; but at each of the recognised stopping-places above mentioned sidings and a goods lock-up are provided for the special purpose of accommodating goods traffic. A goods porter, assisted in one or two instances by a lad, is put in charge of the place, and the lock-up—which may consist of one room, 17 ft. by 11 ft. in area—serves as an office and sack store as well. At the Upwell terminus there is a water tank and pit for the engines. This is practically all that is required in the way of stations. There is neither platform, telegraph nor signalling to be provided.

A gang of one platelayer and three labourers maintains the line.

The rolling-stock consists of five locomotives and nine passenger cars; but for goods, and for passengers also in case of emergency, main-line stock is available.



Traeight feet Tramcar.

WISBECH AND UPWELL RAILWAY.

QUANTITY OF MATERIALS IN ONE MILE SINGLE LINE WITH WROUGHT-IRON GUARD-RAIL.

DESCRIPTION.	No.	Tons.	Cwts.	Qrs.	Lbs.
Steel rails, 50 lbs. per yd., in 30 ft. lengths, 2 in. on the head, 4 in. on the flange, and 4 in. deep, . .	352	78	11	1	20
Wrought-iron guard-rails, 24 lbs. per yd., in 30 ft. lengths, . .	352	37	14	1	4
Cast-iron chair plates, 11 lbs. each, 2 to each sleeper, ...	3600	17	13	2	8
Cast-iron distance-pieces, 3 lbs. each, 18 in. apart, ...	7040	9	8	2	8
Fish-plates for rails, 15 lbs. per pair, .	351	2	7	0	1
Fish-plates for guard-rails, 5 lbs. each, one only at each joint, . .	176		15	2	24
Fish-bolts and nuts, 0·63 lb. each, ¾ in. diam., and 3¼ in. long, . .	1404		7	3	16
Fish-bolts and nuts for guard-rails, 0·51 lb. each, ¾ in. diam., and 2⅛ in. long,	1404		6	1	16
Wrought-iron dog-spikes, 5½ in. long, ⅜ in. square, 0·60 lb. each, 2 to each sleeper, ...	3600		19	1	4
Trenails, compressed oak, 5¼ in. long, 1 in. diam., 1½ in. at shank, 2 to each sleeper, ...	3600				
Sleepers, ...	1800				
Wrought-iron distance-piece bolts, ¾ in. diam., 4⅛ in. long, 18 in. apart, 0·86 lb., ...	7040	2	14	0	6

The cost of a locomotive appears to be about £1400. Fig. 2, Plate VIII., is a diagram of an engine with the casing removed. There is a platform at either end, the driver standing upon the front one, and the reversing wheel and regulator being arranged to work from both ends of the engine. The following details may be noted :—

Cylinders, ...	11 in. × 15 in.
Tractive power, . . .	50·42.
Heating surface of tubes, . .	306·22 sq. ft.
„ „ fire-box, .	43·24 „

Total heating surface,	349·46 sq. ft.
Grate area,	9·70 ,,
Boiler barrel plates,	$\frac{5}{16}$ in. thick.
Back plate,	$\frac{1}{2}$,,
Throat plate,	$\frac{7}{16}$,,
Front tube plate,	$\frac{5}{8}$,,
Fuel capacity,	23 cub. ft., or $\frac{1}{2}$ ton of coal.
Consumption of fuel,	27 lbs. (Welsh coal) per train-mile; 21 lbs. per engine-mile.

Under the Act certain regulations are enforced in regard to locomotives. The engine must be free from noise, produced by blast or the clatter of machinery, such as the passengers or the public might reasonably complain of; and it must not emit smoke or steam to such an extent as they might fairly object to. All fire used by the engine must be concealed from view, and the machinery must be covered at all points above 4 inches from the level of the rails; the engines are boxed in, therefore, with plates at the sides.

The maximum speed permitted is 8 miles an hour; on facing points it must not exceed 4 miles an hour. A governor, therefore, is fitted to each engine (or, as the permanent-way inspector expressed it, the engine is "slotted"), so that when the speed of the engine exceeds 10 miles an hour it shall cause the steam to be cut off and the brakes applied.

The engine must be provided with a speed-indicator; with a special bell, to be sounded as a warning as may be necessary; and with a suitable fender, in order to ward off obstacles. The fender attached to each end of the engine is an uncompromising, straight-edged gridiron, commonly called a "cow-killer," whereas the V-shaped "cow-catcher"—used in India, America, and elsewhere—would throw a man or animal (which had broken through the fence and was caught on the line) off sideways, and would not necessarily kill him or it outright.

Each coupled wheel must be fitted with a brake-block, which may be applied by screw, by treadle, or by other means, and also by steam. The Westinghouse and hand brakes are used. The engine and cars must be capable of being brought to a stand-still at certain places, and, in case of emergency, within a reasonable distance. Accordingly, the Westinghouse brake is fitted to all cars, as well as engines.

The cost of the nine cars was £2485. They are of different patterns. Fig. 3, Plate VIII., is a diagram of an 18 ft. four-wheel composite carriage, with two compartments, to seat eight first-class and sixteen third-class passengers. Fig. 4, Plate VIII., is a diagram of a 28 ft. composite carriage on bogies, to carry ten first-class and twenty-two third-class passengers, and weighing, when empty, 10½ tons. Both types have platforms and doors at each end, by which the passengers may enter and leave the compartments, and a central gangway through which the conductor may pass from end to end of the train, there being a sliding door opening between the compartments, flaps let down over the couplings, and hand-rails projecting from one platform to another.

The maximum permissible loads are—for passenger trains, 9 vehicles (the two larger tramcars each to count as 2 vehicles); for mixed trains, 10 vehicles, 4 of which may be loaded goods trucks; and for coal trains, 4 loaded trucks in winter and 5 in summer.

The time-table provides for a daily service of 6 passenger and 3 goods trains from Wisbech to Upwell, and of 7 passenger and 3 goods trains from Upwell to Wisbech. No coal or dead buffer trucks are to be worked by these tramcar trains; a special trip has to be run for the working of such traffic.

An ordinary passenger train may include an engine, three cars, and a brake-van, more cars being required, perhaps, on Saturdays. The train staff consists of a driver, a fireman, and a conductor; the last sells tickets.

Two drivers and two firemen are employed on the line at one time; and the following locomotive staff is charged to the tramway:—

3 drivers.
3 firemen.
2 cleaners.
¼ working foreman, shop fitters, etc., when an engine is under repairs.

The following are the permanent traffic staff engaged on the tramway:—

1 conductor.
2 lad porters.
1 acting guard.

And assistance is rendered by the Wisbech Station staff as follows:—

Porter and pointsman, cleaning cars.
Lampman, lighting cars.
Parcels porter, to deal with parcels on and off trams.
Clerks, doing the necessary clerkage.

The rates and fares are given in the accompanying statements. It will be noticed that the first-class passenger fare to Upwell, 4d., is at the rate of only ⅝d. per mile, and the third-class fare, 3d., at the rate of only ½d. per mile. The Wisbech goods rates, including collection or delivery, *cover the haulage over the tramway, and no additional charge is made.*

During the year ending 30th June 1896, the gross receipts amounted to £2632 (about £337 per mile per annum, or £6½ per mile per week); the working expenditure to £2212; and the net revenue, therefore, to £420.

Of the gross receipts, £1013 was from passengers; £43 from

WISBECH AND UPWELL TRAMWAY.

The Wisbech rates, including collection or delivery, cover the haulage over the Tramway, and no additional charge is made.

The following charges are made on Merchandise from or to Wisbech, when charged at station to station rates.

On traffic passing over the railway. On traffic not passing over the railway.

Between Wisbech and	Merchandise in Classes 1 to 5 of General Railway Classification. Carted in Wisbech only.		Merchandise in Classes A, B, and C of General Railway Classification. Station to Station.		Packed Manure, 5 tons. Station to Station.	Coal, 6 tons.	Coke. 4 tons	Classes A and B of General Railway Classification 4 tons.	Packed Manure 5 ton loads.	Potatoes. 5 ton loads.	Grain. 5 ton loads.	Oil Cake. 5 ton loads.	Other Station to Station Merchandise in General Railway Classification Minimum 2 tons.	Merchandise in Classes 1 to 5 of General Railway Classification Minimum 3d.
	Per ton.	*Minimum*	*Per ton.*	*Minimum*	*Per ton.*	*Per ton.*	*Per ton.*	*Per ton.*	*Per ton.*	*Per ton.*	*Per ton.*	*Per ton.*	*Per ton.*	*Per ton.*
Elm Bridge	3/4	2d.	10d.	2 tons	...	2d.	3d.	3d.	...	...	...	...	5d.	1/8
Boyce's do.	3/4		1/3		...	3d.	5d.	4d.	...	...	...	...	5d.	1/8
Outwell Basin	5/0	3d.	1/8		...	4d.	7d.	6d.	...	...	...	...	10d.	1/8
,, Village	5/0		2/1		...	6d.	10d.	9d.	10d.	10d.	10d.	10d.	1/3	1/8
Upwell	6/8		2/6		2/1	8d.	1/1	1/0	10d.	10d.	10d.	10d.	1/8	1/8
Elm Bridge and	Station to station.													
Boyce's Bridge	3/4	2d.	10d.	2 tons	...	...	...	...	...	...	...	...	...	...
Outwell Basin	3/4		10d.		...	...	...	...	...	...	...	...	...	...
,, Village	3/4		1/8		...	...	...	...	...	...	...	...	...	...
Upwell	5/0	3d.	2/6		...	...	...	...	...	...	...	...	...	...
Boyce's Bridge & Outwell Basin	3/4	2d.	10d.	2 tons	...	...	...	...	...	...	...	...	...	...
,, Village	3/4		1/8		...	...	...	...	...	...	...	...	...	...
Upwell	5/0	3d.	2/6		...	...	...	...	...	...	...	...	...	...
Outwell Basin & Outwell Village	3/4	2d.	10d.	2 tons	...	...	...	...	...	...	...	...	...	...
Upwell	3/4		1/8		...	...	...	...	...	...	...	...	...	...
Outwell Village and Upwell	3/4	2d.	10d.	2 tons	...	...	...	...	...	...	...	...	...	...

Goods Manager's Office (G.E.Ry.), Liverpool Street Station, 8/2/97.

WISBECH AND UPWELL TRAMWAY.

FARES.

Miles.		Wisbech.		Elm Bridge.		Boyce's Bridge.		Outwell Basin.		Outwell Village.		Upwell.
		1st Class.	3rd Class.	1st Class.	3rd Class.	1st Class.	3rd Class.	1st Class.	3rd Class.	1st Class.	3rd Class.	
1½	Elm Bridge, . . .	2d.	1d.									
3¼	Boyce's Bridge, . .	3d.	2d.	2d.	1d.							
4¼	Outwell Basin, . .	3d.	2d.	3d.	2d.	2d.	1d.					
5	Outwell Village, . .	4d.	3d.	3d.	2d.	3d.	2d.	2d.	1d.			
5¾	Upwell, . . .	4d.	3d.	4d.	3d.	3d.	2d.	2d.	1d.	2d.	1d.	

parcels and mails; £1565 from animals, goods, and minerals; and £11 from other sources.

The working expenditure was thus distributed:—

Maintenance of way and works,	£355
Locomotive power,	866
Repairs and renewals of engines,	308
Repairs and renewals of cars,	13
Traffic expenses,	580
Rates, taxes and tolls,	69
Goods claims,	21
	£2212

No charge, of course, was made for direction, management, and supervision; nor, it may be added, was any required on account of compensation for personal injury, although the line runs across, and on the side of, the public roads.

The car-mileage amounted to 32,896, and the number of passengers conveyed was 103,639. The total inward goods traffic was 19,504 tons, and outward goods 16,921 tons.

The gross traffic receipts during five years have been £2338 in 1892, £2541 in 1893, £2570 in 1894, £2395 in 1895, and £2621 in 1896.

Traffic is busiest in the winter, when at Upwell as many as 13 or 14 trucks, perhaps, are loaded up daily, the general average being about 10. Lynn sends oil-cake, maize, and barley. From the neighbourhood, by means of the intermediate sidings, are brought apples, potatoes, carrots, etc. As a rule, mangolds cannot bear the freight charges. If the farmer's men are not busy, he will often cart them to Stonea, six or seven miles off, instead of the two or three miles to Upwell, and may thus save as much as 2s. a ton in railway carriage. When the demand for new potatoes in the London market has relaxed, and the imports from Jersey and the Continent crowd out home produce, the farmers store their potatoes till the winter, when most of this traffic is carried.

The summer fruit traffic has encouraged the farmers, year by year, to put more of their land under such cultivation.

On the whole, the results are considered to be satisfactory both to the company and to the district served by the tramway. Net receipts of £420 on a capital expenditure of £41,926—or little more than 1 per cent.—may not bulk largely in the returns published each year, but we must remember that these figures correspond with the haulage on the light section only, and that there is a much greater, if unrecorded, profit to the company due to the additional traffic, more especially in apples, potatoes, and other agricultural produce, created and fostered by the tramway, and carried over the main line to

London at an additional working expenditure which is scarcely appreciable. English railways earn their dividends hardly, and cannot afford to be too philanthropical, but, given facilities for throwing out economical feelers and feeders, they are ready enough to add an honest penny to their revenue, and to benefit the country districts.

We are here in the very centre of the eastern or arable section of England. The wheat area has been shrinking eastward for the last twenty years, but there have recently been increases in barley, oats, and potatoes, principally in the eastern counties, which may partly compensate for the decrease of wheat cultivation. This corner of England comes next to Lincolnshire, Lancaster, and, perhaps, Chester, as a source of supply of potatoes. The produce of mangolds, wheat, and barley, too, is fairly large, and it is satisfactory to know that, in the neighbourhood of the Wisbech and Upwell Tramway, more land is every year being devoted to the cultivation of fruit and potatoes.

The surface of this Fen country is, of course, flat. Very little bridging had to be provided. The road was broad enough to take the tramway on one side; only for a short distance was it considered necessary to cut a corner and take up land for the purpose. No fencing or partition from the public road was required. Competition for traffic on the part of road or canal has not been formidable, and, altogether, the circumstances have been favourable and the results satisfactory. A saving in capital cost would have been made had it been practicable to dispense with the guard-rail at once, and to use old but serviceable rails set free from the main line.

It would appear that the railway companies may very well take advantage of the Light Railways Act, 1896, in two obvious ways—(1) by constructing short feeders and branches with old rails and fish-plates (but *not* with old sleepers), and (2) by *disclassing* certain existing branch lines or sections of small traffic.

The Three Horse-Shoes and Benwick Line, G. E. R.—A light goods line, on the standard gauge, from Three Horse-Shoes (a goods depôt between March and Whittlesea) to Benwick, in the Isle of Ely, Cambridgeshire, is being constructed by the Great Eastern Railway under their General Powers Act of 1895 [58 & 59 Vict. session 1895]. It is to be a single track, 4 miles 3 fur. 2·70 chains long, with a wharf or quay on the north-west bank of the river Nene. The railway is not to carry passengers, but main-line goods stock, including engines, may circulate freely on it.

The branch takes off, by a back-shunt, from the Three Horse-Shoes goods station on the main line, and runs over the flat low-lying fen-land, through Quaker's Drove, West Fen Drove, Burnt House Drove depôt at 2 miles 29 chains, Jones' Drove, and White Fen Drove—farmers' depôts, with sidings and lock-ups on the same pattern as on the Wisbech and Upwell Tramway—to Benwick.

The line is so directed across the fields as to interfere with the drains and dykes as little as possible.

The track consists of old second-hand 80 lb. bull-headed steel rails, released from the main line, fished with second-hand fish-plates weighing 43 lbs. a pair and new fish-bolts and nuts, and supported in new cast-iron 43 lb. chairs, which are held with new keys, and fastened with new spikes and trenails to new creosoted sleepers. The estimate allows for 12 in. of ballast under the sleeper, and as the soft soil, yielding to the effect of the fen drainage, must absorb a good deal of the ballast, an inferior quality is first put in to get a bottom, and the best is reserved for filling and packing.

The probable cost per mile of such track may be estimated at about £972, as shown in the accompanying table. The figures may be compared with the alternative estimate of about £868 per mile for a light line laid with new 56 lb. F.F. steel rails, spiked directly to the sleeper. New chairs had to be provided, because the old standard chair was too high-lipped for worn rail-heads; and in such lines as we are considering, we may safely assume that it will be most economical in the long-run to use new sleepers and new fastenings, and only to take rails, fish-plates, and chairs second-hand, if they are available from the main line. The rate quoted for old rails and fish-plates is, of course, not one that can be fixed with great accuracy; at the best, it can only represent a book value.

The country traversed is flat and low; the level drops, perhaps, as much as an inch per annum in consequence of drainage operations; and the soil is very soft. Accordingly, the troughs which conduct the dykes under the line are laid low enough to allow for sinkage in the bed; and pile foundations are driven to a considerable depth to carry the line over the larger engine-drains. As an alternative to steam-power, wind-mills are erected to work the pumps on these engine-drains, and the sight of them is a pleasant relief to the general monotony of the landscape.

The construction of the timber troughs—of which there are about twenty-five—is at once simple and economical (fig. 1, Plate IX.). Including the clearing out of the dyke, one of the most expensive items, the cost of each is probably not more than £6 or £7. The effective section is 18 in. square, each side being built up with two planks 9 in. wide and 3 in. thick, laid longitudinally on edge, one over the other, the floor and cover of the trough consisting also of 3 in. planks.

The type of timber bridge adopted to carry the railway over the engine-drains—which have to be crossed in four or five instances, although the intersection of water-courses is avoided as far as possible—consists (fig. 2, Plate IX.) of a 12 or 15 ft. span on piles driven to a depth of about 24 ft.

Over the river Nene is to be built a bridge (fig. 3, Plate IX.) consisting of four small spans, and a central one of 25 ft. 6 in., for which old wrought-iron girders are available. The pile foundations will reach to a depth of 34 ft. The minimum headway, about 9 ft. clear, is sufficient for barges to pass under the girders.

The fencing is an expensive item, grudgingly provided by the thrifty engineer. It is of the usual wooden post and rail pattern,

APPROXIMATE COST OF ONE MILE OF PERMANENT-WAY, WITH SECOND-HAND 80 LB. RAILS AND FISH-PLATES FROM MAIN LINE.

Tons.	Cwt.	Qrs.	Lbs.	No.	Description.	Rate.			£	s.	d.
						£	s.	d.			
114	0	0	0	Approx.	Bull-headed rails, old second-hand, 80 lbs. to the yard originally, . . .	2	5	0	256	10	0
6	15	0	16		Fish-plates, second-hand, 43 lbs. a pair, . . .	2	5	0	15	4	9
0	17	1	4	1408	Fish-bolts and nuts,	9	7	2	8	1	10
74	6	2	8	3872	Chairs, 43 lb.,	3	0	0	222	19	8½
				3872	Keys, per 1000 new.	4	0	0	15	9	9
				7744	Trenails,	2	2	6	16	9	1
4	15	0	8	7744	Spikes,	7	8	10	35	7	6
				1936	Creosoted sleepers,	0	3	1	298	9	4
				1760	Yards run, labour in laying,	0	1	0	88	0	0
					Use of loco. for distributing, say, ...				15	0	0
									£971	12	0

APPROXIMATE COST OF ONE MILE OF PERMANENT-WAY, WITH NEW 56 LB. VIGNOLES RAILS AND OTHER MATERIAL.

Tons.	Cwt.	Qrs.	Lbs.	No.	Description.	Rate.			£	s.	d.
						£	s.	d.			
88	0	0	0	...	Steel rails, flat-footed, 56 lbs. to the yard, . . .	4	15	0	418	0	0
5	0	0	0	...	Fish-plates, . . .	5	10	0	27	10	0
0	14	0	0	...	Fish-bolts, ...	9	10	0	6	13	0
2	10	0	0	...	Dog-spikes, . . .	8	0	0	20	0	0
...				1936	Creosoted sleepers, . .	0	3	1	298	9	4
...				1760	Yards run, labour in laying,	0	1	0	88	0	0
					Use of loco. for distributing, say, ...				15	0	0
									£867	12	4

and may cost 1s. 5½d. or 1s. 6d. a yard. As a ditch will be dug and a raised thick-set hedge planted within the fence—making up the ultimate cost to about 2s. a yard—the latter will not require renewal as it wears out.

Sufficient land has been taken up by agreement with the farmers, at an all-round price of £30 per acre, to allow for doubling the track, if necessary, hereafter; while, at the "droves" or depôts, the width from fence to fence will leave ample room for a 30 ft. roadway beyond the sidings.

The plan of these sidings is that of a loop with two dead ends (fig. 4, Plate IX.), and carts approach by the usual unmetalled fen road, crossing the railway at one end of, and running parallel to, the sidings. The loop is long enough to hold 25 trucks, allowing 20 ft. for each. The plan of the depôt at Benwick is shown in fig. 5, Plate IX.

A rough estimate of the cost of way and works for a light railway in the Fens is given on the next page.

There is a very heavy traffic, principally coal, from *viâ* Peterborough to March and onward, over that portion of the main line with which the Benwick branch connects, as many as 40 specials sometimes running in a day. Of local agricultural produce, carrots, potatoes, and other roots form the bulk of the traffic. The farmers to be served by the new branch own or rent large holdings and are well-to-do, so that there is every prospect of the Benwick line paying.

The Easingwold Railway.—The Easingwold Railway is owned and worked by a private company. It was constructed as an ordinary railway under a special Act of 1887, and runs out from Alne, on the North-Eastern Railway, to Easingwold, a distance of 2 miles 37 chains. The line was opened in July 1891.

The cost was as follows:—

(*a*) Parliamentary and legal expenses,	£1,267	3	7
(*b*) Way and works,	11,973	3	10
(*c*) Locomotive,	1,119	0	0
(*d*) Coaches,	301	9	7
(*e*) Land,	2,300	8	8
	£16,961	5	8

This railway is not—like the Wisbech and Upwell Tramway—laid on a public road, but—like the Three Horse-Shoes and Benwick light goods line—right through the fields.

After clearing the points at Alne, the permanent-way changes from the bull-headed rail in chairs of the main line to a 21 ft. 60 lb. flat-footed steel rail resting directly on the sleeper. To the guard sleepers—those nearest the rail-joint—and to the middle two the rail is fastened by an inside and outside fang-bolt and clip, the bolt passing through the flange of the rail; to the other sleepers the rail is held down by two dog-spikes on the outside and one on the inside. The

Rough Estimates of Cost of One Mile of Light Goods Railway in the Fen District.

Quantities, Descriptions, and Rates of Items.				With Old 80 Lbs. Bull-headed Rails.	With New 56 Lbs. Flat-Footed Rails.
Yards.		Description.	Rate.	£ s. d.	£ s. d.
3520	Run.	Fencing with quickset and ditch complete, ...	2/	352 0 0	352 0 0
	Acre.	Land, six acres to the mile, ...	£30	180 0 0	180 0 0
	Mile.	Permanent-Way, as shown in detail above, ...	(11/ or 10/ approx.)	968 0 0	880 0 0
4860	Cube.	Ballast, ...	2/	486 0 0	486 0 0
	No.	6 Timber trough culverts, 1 ft. 6 in. × 1 ft. 6 in., ...	£7	42 0 0	42 0 0
	No.	1 Timber bridge, over engine-drain, on piles, ...	£30	30 0 0	30 0 0
	No.	1 Goods Depôt, including sidings (proportion), ...	for	1000 0 0	800 0 0
				£3058 0 0	£2770 0 0

sleepers—of the usual dimensions, 9 ft. by 10 in. by 5 in.—are of uncreosoted larch, the intervals between them being 32 ins., centre to centre; they are packed in stone ballast. The line is maintained by only two platelayers.

The railway is practically a surface line. The steepest gradient is 1 in 100. There is no other bridging than a 10 ft. girder spanning a small stream between Alne and Crankley. The line of fencing has been planted with thick-set, but that does not seem to thrive.

There are two level-crossings—"Ben Smith's" and Crankley—each provided with gates, a lodge and a siding, and tended by a gatekeeper, who is the wife of a platelayer. The siding is connected with the running line by a crossover, not a turnout.

At the present terminus, Easingwold, are a passenger-station building and platform; a goods shed of corrugated iron and a platform; an engine shed of corrugated iron, with an engine pit, bench and vice, forge, sand oven, cupboard for oil and waste, etc.; a coal stage, a load gauge, a weighing-machine, a water column, and a depôt belonging to the "Farmers' Trading Company," with a raised platform, a siding running up to it, and coal-shoots on the off side.

The small passenger-station building contains an office-room for the secretary, another for the station-agent, a waiting-room, and a lamp-room.

The Easingwold Station points are locked and controlled by an Annett's key, kept and used by the guard or driver, and applicable also to the siding points at "Ben Smith's" and Crankley level crossings. As is well known, the possession of such a key places the control of all these points in the hands of its holder, and it cannot be removed from the lever until the line has been re-made for through running.

The rolling-stock consists of one locomotive engine and two passenger coaches.

The locomotive, a small six-wheels-coupled tank-engine, with a 12 in. by 18 in. cylinder, weighs not more than 20 tons 3 or 4 cwts. when fully loaded with coal and water, but takes a load of two passenger coaches and eight or ten loaded goods wagons. It carries 10 cwts. of coal and 450 gallons of water, ample for the short runs to and fro; and, the grades being easy, it is provided with a hand brake only.

One of the passenger carriages has a compartment occupied by the guard, who controls a hand brake and has charge of the luggage.

Goods stock belonging to the main line is taken over and used on the branch, subject to demurrage charges after two days' detention.

The train service—much more liberal than probably a trunk line, working such a branch, would care to provide—consists of no less than nine trains each way. That this should be possible is a remarkable example of economical working on a very small scale, and with a separate, small, but sufficient staff, *i.e.*, under independent and, therefore, very difficult conditions. Such results could only be obtained by the readiness of every servant of so small a staff to do anything that is required of him. Their duties must be largely interchangeable.

Thus, the running staff consists of two men, who act as guard and driver alternately, and of a fireman. And at certain times one driver relieves the fireman, in which case—as mentioned below—one of the station porters acts as guard.

The station staff consists of an agent, two clerks, and two porters at Easingwold. One of the latter does "guard" for the last two trains. Such versatility of service is the very essence of economical light-railway working.

It is just as evident in the administrative staff, which consists of the secretary, Dr Buller Hicks, whose valuable services are purely honorary, and of his paid assistant-secretary, Mr Bensley, who is also the secretary of the "Farmers' Trading Company" above referred to. Thus, the costs of superintendence and administration—so likely to bulk largely in the expenditure of a separate organisation on such a small scale—are reduced to a minimum.

The rates are fixed in agreement with the North-Eastern Railway Company, who determine the through rates, and allow the Easingwold Railway Company a proportion.

There are two Parliamentary trains daily, the first and last each way. The passenger fares are 3d., 4d., and 6d., third, second, and first-class respectively, and the return charges are double.

A progressive revenue account may be thus abstracted:—

Half-Years.	Receipts.			Expenditure.			Balance.		
	£	s.	d.	£	s.	d.	£	s.	d.
Dec. 1891	635	4	1	488	12	5	146	11	8
June 1892	662	15	10	579	17	3	82	18	7
Dec. ,,	647	16	2	675	15	0	27	18	10*
June 1893	656	6	4	528	16	3	127	10	1
Dec. ,,	753	3	1	563	16	10½	189	6	2½
June 1894	692	10	7	480	3	9	212	6	10
Dec. ,,	866	4	3	515	14	2½	350	10	0½
June 1895	722	8	4	445	13	3	276	15	1
Dec. ,,	829	15	1	515	5	1	314	10	0
June 1896	743	11	11	467	16	1	275	15	10
Dec. ,,	892	5	3	501	12	1	390	13	2

* Deficit.

The half-yearly balances have been largely diminished by mortgage interest and the reduction (and, at the end of 1896, the obliteration) of the debit balance on capital account.

Of the series of revenue accounts, etc., placed at the writer's disposal by Dr Buller Hicks, it will be sufficient to quote in detail those for the fifth half-year ending 31st Dec. 1893, and for the eleventh half-year ending 31st Dec. 1896.

The decreases under nearly every item of expenditure, accompanied by increased receipts, are encouraging.

The receipts for merchandise are shown *less* cartage. The difference is paid to a rulleyman for cartage, and, at the rate of 1s. 3d. per ton, amounts to about £4 per mensem, or £50 per annum. The rulley belongs to the Easingwold Railway Company, the horse to the man.

The proportion per cent. of expenditure to receipts has been reduced from 75 during the second half-year of 1893 to 56 during that of 1896.

The receipts from passengers during the second half-years of 1893 and 1896 were made up as follows :—

Number.		Description.	Half-year ending 31st December.	
1893.	1896.		1893.	1896.
			£ s. d.	£ s. d.
494	432	First-Class, . . .	12 4 9	10 14 0
...	17,439	Second-Class, . .	... ...	284 8 6
23,238	2,315	Third-Class, . .	275 5 6	26 3 0
23,732	20,186	Season Tickets, . .	3 14 0	3 16 0
			£291 4 3	£325 1 6

Although the number of passengers was less in 1896, the receipts were larger ; and the inference is that, on such short journeys, people prefer to pay somewhat more, and travel second-class. This seems to show that, if it is necessary to charge somewhat higher rates and fares on short light railways, each individual member of the public can afford to pay the difference on so short a distance ; as a particular item of expenditure it is trifling to the customer, in the aggregate it enables the railway to survive.

The outward goods traffic consists of agricultural produce in general, and of grain, hay, and potatoes more especially. The hay is carried as far as Haltwhistle in Northumberland, and the potatoes to

EASINGWOLD RAILWAY.—REVENUE ACCOUNTS FOR HALF-YEARS ENDING 31ST DECEMBER 1893 AND 1896.

Dr. REVENUE ACCOUNT. *Cr.*

Expenditure for the Half-year ending	31st Dec. 1893.	31st Dec. 1896.	Receipts for the Half-year ending	31st Dec. 1893.	31st Dec. 1896.
To	£ s. d.	£ s. d.	*By*	£ s. d.	£ s. d.
Maintenance of Way, Works, and Stations, ...	73 17 11	64 2 0	Passengers, ...	291 4 3	325 1 6
Locomotive Power, ...	205 2 7	179 5 8	Parcels, Horses, Carriages, etc., .	35 16 10	43 0 11
Carriage and Wagon Repairs, .	6 13 3	1 6 6	Mails, ...	12 10 0	12 10 0
Traffic Expenses, ...	230 9 10	190 1 3	Parcels Post, ...	17 15 6	6 0 7
General Charges, ...	37 6 0	28 3 6	Merchandise, less Cartages, . }	288 19 0	369 9 5
Compensation, ...	...	1 7 8	Live Stock, ... }		9 9 0
Rates and Taxes, ...	9 0 6½	21 1 4	Minerals, ...	87 16 11	109 19 5
Government Duty, ...	0 11 11	15 18 7	Transfer and Registration Fees, .	0 5 0	0 5 0
Demurrage, ...	0 12 6	...	Rents, ...	11 10 0	5 17 4
Carriage of own Goods, ...	0 2 4	0 5 7	Special Services to Trading Co., .	7 5 7	10 12 1
Balance carried to Net Revenue Account, ...	189 6 2½	390 13 2			
	£753 3 1	£892 5 3		£753 3 1	£892 5 3

NET REVENUE ACCOUNT.

To	£ s. d.	£ s. d.	*By*	£ s. d.	£ s. d.
Balance to Debit, ...	116 1 10	...	Balance from Revenue Account, .	189 6 2½	390 13 2
Mortgage Interest, less Income Tax, }	90 2 0	79 5 4	Balance to Debit, ...	16 17 7½	...
Bank Interest, ... }		1 11 6			
Balance to be Appropriated, . .	...	309 16 4			
	£206 3 10	£390 13 2		£206 3 10	£390 13 2

The Appropriation of Balance of Net Revenue Account was, on 31st December 1893, Balance to Debit, £16 17s. 7½d. Of the Balance of £309 16s. 4d. available on 31st December 1896, £215 17s. 9d. was required to obliterate the Debit Balance on Capital Account, and £93 18s. 7d. remained to be carried forward.

London. Inwards the traffic consists mainly of grain, manure, lime, coal, etc. All the coal and lime are received from Yorkshire and Durham collieries and kilns, and amounted to 4170 tons in 1896. The total tonnage of goods in that year was 14,546.

Very roughly, 40 per cent. of the gross receipts was contributed by passengers.

Among other—not indirect, but rather very direct—benefits which Easingwold and the neighbourhood owe to the railway are an earlier and more frequent postal delivery.

At Alne, their junction with the North-Eastern Railway, the Easingwold Railway Company do their own shunting, but the main-line staff perform booking, clerking, and other station services for them at a small annual charge. Engine and carriage repairs are carried out in the North-Eastern Railway workshops. In the division of earnings in station facilities, and other matters, the main line is liberal to the branch. For example, on such occasions as agricultural show and other special days, the North-Eastern Company help freely, without reference to the actual working agreement.

Applications under the Light Railways Act.—Of light railway proposals since the passing of the Act of 1896 there is now something to be said.

When the Light Railway Commissioners sent up their first order, the Board of Trade decided—with reference to section 8 (2) of the Act—"to publish a short notice of the making of the order by the Commissioners, and of its submission for confirmation, in the form of an advertisement once in each of two successive weeks in the local newspaper which had contained the original notice of the application, accompanied by an intimation that any objections must be lodged with the Board of Trade within three weeks from the publication of the first advertisement."* Objections having been duly received by the department, the Board appoint a day for the consideration of the order, and give all objectors an opportunity of being heard. The Board then consider the order with special reference to the points mentioned in section 9 of the Act, viz.—(*a*) the expediency of requiring the proposals—on account of the magnitude of the undertaking or its effect on an existing railway company—to be submitted to Parliament, (*b*) the safety of the public, and (*c*) any objections that have been lodged with them. It is from the zeal of the Board of Trade in attempting to ensure the safety of the public that light railways have most to dread. It will be extremely difficult for that department first of all to tear themselves free from the old traditions, and afterwards to avoid drifting back into the old ways; it can only be by their steady determination to include no provisions in the name of safety which are unreasonable or inexpedient. If the Board, after making such amendments as they consider requisite, confirm the order, notice is given in the *London Gazette* of the confirmation, and the promoters are required to supply the public with copies of the order at a price not exceeding 1s. a copy.

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* *Report of the Proceedings of the Board of Trade under the Light Railways Act*, 1896, during the period ending 31st December 1897, etc.

The Light Railways Act came into operation on the 14th August 1896. The Board of Trade immediately issued to local authorities a memorandum drawing attention to its provisions, and in September 1896 made rules * with respect to applications to the Commissioners for orders authorising light railways. In the month of December 1896 applications were made for fifteen light railways in England, three in Wales, and ten in Scotland; and the Commissioners held their first local inquiry at Basingstoke on the 28th January 1897, when Sir Charles Scotter (general manager of the London and South Western Railway) gave a description of his company's proposal to connect Basingstoke on the main line with Chawton on their Farnham, Alton, and Winchester line, by means of a light railway.

Of these twenty-eight schemes † the following were withdrawn:—

Length.	Gauge.	Engineer's Estimate.	
M.	Ft. In.	£	
9	3 6	50,171	Cheltenham and District (Cheltenham to Winchcombe).
12½	3 6	68,685	Norwich and District.
9½	4 8½	...	Gifford and Garvald.

The following were rejected :—

L	Gauge.	Engineer's Estimate.	
M.	Ft. In.	£	
8¼	4 8½	52,784	Darenth Valley (Dartford to Eynesford).
22	do.	89,469	Dartford District (Dartford to Eynesford, Wilmington to Swanley, Farningham to Stansted).
26	3 0	36,938	Grimsby and Saltfleetby.
4½	3 6	28,418	Llandudno and Colwyn Bay.
17¼	4 8½	108,571	Aberdeenshire (Aberdeen to Skene of Echt).
6½	do.	58,970	Midlothian (Edinburgh and District).

One was deferred :—

Length.	Gauge.	Engineer's Estimate.	
M.	Ft. In.	£	
14	4 8½	41,343	Llanfair and Meifod (Llanfair to Arddleen).

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* Appendix IX.

† *Report of Proceedings of Board of Trade and of Light Railway Commissioners under Light Railways Act* (dated December 1897).

The following 18 were approved:—

Length.	Gauge.	Engineer's Estimate.	
M.	Ft. In.	£	
9¾	3 6	49,231	Crewe.
2	4 8½	19,643	East and West Yorkshire Union (Robin Hood to Royd's Green, Lower).
11	2 6	30,565	Elsenham, Thaxted, and Bardfield.
8¼	4 8½	44,978	Flamborough and Bridlington.
11½	do.	49,045	Hadlow (Tunbridge to Claygate Cross and to Nettlested).
11½	3 6	67,596	Isle of Thanet (Ramsgate and Margate).
13	4 8½	66,715	London and South-Western Railway Company —Basingstoke and Alton.
14	4 0	83,966	Potteries (Longton and District).
2¾	3 6	17,564	West Hartlepool.
7	4 8½	24,991	Wrington Vale.
12½	do.	59,040	Gower (Clyne Wood to Port Eynon).
5¼	do.	...	Carmyllie (Elliot Station to Carmyllie Quarries).
18½	do.	76,030	Cromarty and Dingwall.
14½	do.	53,511	Forsinard, Melvich, and Portskerra.
13	do.	60,000	Great North of Scotland Railway—Echt Light Railway (Aberdeen to Kirktown of Echt).
10½	do.	48,309	Lauder (Fountainhall Station to Lauder).
7¾	do.	31,962	Caledonian Railway—Leadhills Light Railway (Elvanfoot Station to Wanlockhead).
7½	do.	26,756	The Mound, Embo, and Dornoch.

Of those approved by the Commissioners the following were submitted to the Board of Trade for confirmation:—

Basingstoke and Alton.
East and West Yorkshire Union.
Potteries.
Hadlow.
Wrington Vale.
Gower.
Crewe.
Flamborough and Bridlington.
West Hartlepool.

And the first four of these were confirmed by the Board of Trade in December 1897.

Treasury assistance was sought by none under section 4 of the Act (in addition to advances made by any county, borough, or district council), but by the following under section 5 :—

Elsenham, Thaxted, and Barnfield.
Llanfair and Meifod.
Cromarty and Dingwall.
Forsinard, Melvich, and Portskerra.
The Mound, Embo, and Dornoch.

Assistance from local authorities was sought by the following :—

Elsenham, Thaxted, and Barnfield.
Flamborough and Bridlington.
Cromarty and Dingwall.
Forsinard, Melvich, and Portskerra.
Lauder.
The Mound, Embo, and Dornoch.

Objections on the part of town corporations, district councils, or other local authorities affected, insufficient public need to justify the compulsory acquisition of land in the face of strong opposition, undue interference with the interests of landowners, ineligibility of what are essentially urban tramway schemes, failure to prove the need for the line in the public interest, non-compliance with the rules of the Board of Trade—such are the grounds upon which applications may be rejected.

Omitting the Gifford and the Garvald (9½ miles), and the Carmyllie (5¼ miles)—for which the estimated cost is not given—the total length of twenty-six light railways of various gauges is approximately 295 miles, and the engineers' estimates amount to £1,345,251, so that the average estimated cost per mile is about £4560.

In May 1897 also twenty-eight applications were made for orders authorising light railways—19 in England, 4 in Wales, and 5 in Scotland. Of these the following were withdrawn :—

Length.	Gauge.		Engineer's Estimate.	
M.	Ft.	In.	£	
⅜	4	8½	6,019	Corporation of London Foreign Cattle Market, Deptford.
4	3	6	23,329	Torquay and Paignton.
10¾	4	8½	56,160	Dunfermline and Kincardine.

The following were deferred :—

Length.	Gauge.	Engineer's Estimate.	
M.	Ft. In.	£	
10	4 8½	45,500	Kelvedon, Tiptree, and Tollesbury (Kelvedon to Blackwater River).
6	3 6	75,385	Norwich and district (No. 2).
8¾	4 8½	32,395	Rea Valley (Minsterley to Chirbury).
8¼	3 6	65,083	Llandudno and Colwyn Bay (Colwyn Bay to Deganroy.

The following were rejected :—

Length.	Gauge.	Engineer's Estimate.	
M.	Ft. In.	£	
3½	4 8½	17,980	Lastingham and Sinnington.
2	3 6	11,228	Taunton (wholly within the borough).
10½	2 6	24,250	Llanfyllin and Llangynog.

And 18 are shown as approved or passed by the Commissioners :—

Length.	Gauge.	Engineer's Estimate.	
M.	Ft. In.	£	
9½	4 8½	44,413	Bridlington, Beeford, and North Frodingham.
24	do.	106,250	Dartford District (Stone to Stansted and Swanley).
12	4 0	43,594	Derby and Ashbourne.
8¾	3 6	51,563	Dudley and District (Dudley to Stourbridge).
14	4 8½	59,602	Goole and Marshland (Rawcliffe to Adlingfleet).
17¼	do.&2 6	128,481	Leek, Caldon, Low, and Hartington.
9	4 8½	34,751	Lincolnshire and Northamptonshire (Peakirk to Portland).
11¼	do.	68,587	Lizard (Helston to the Lizard).
12½	do.	30,343	North Holderness (Beverley to Beeford).
20¾	do.	116,407	Great Western Railway Company (Pewsey and Salisbury).
1½	do.	16,741	St George and Hanham (Summerhill Road, Bristol to Hanham).
5¼	do.	69,255	West Manchester (approved in part).
15	do.	45,954	Tanat Valley (Porthywæn to Llangynog).
9¼	2 6	21,309	Welshpool and Llanfair.
4½	4 8½	56,160	Fraserburgh, and St Combs.
13	do.	88,700	Gifford and Garvald (Ormiston to Garvald).
3¼	do.	131,691	Great North of Scotland Railway—Echt extension.
18¾	do.	110,000	West Highland Railway—Loch Fyne (Arrochar to Loch Fyne, opposite Inveraray).

Treasury assistance under section 4, and assistance from local authorities, were sought by the following:—

Bridlington, Beeford, and North Frodingham.
North Holderness.
Rea Valley.
Llanfyllin and Llangynog.
Tanat Valley.
Welshpool and Llanfair.

And of these the following:—

Rea Valley,
Llanfyllin and Llangynog,

sought Treasury assistance under section 5 as well.

The following:—

Kelvedon, Tiptree, and Tollesbury,
Leek, Caldon, Low, and Hartington,
Fraserburgh and St Combs,

sought Treasury assistance under section 5, and of these one:—

Leek, Caldon, Low and Hartington,

sought assistance from local authorities as well.

Omitting—for reasons presently to be given—the Corporation of London Foreign Cattle Market, Deptford (3 furlongs in length), the Taunton (2 miles), and the Echt Extension (3¼ miles), the total length of 25 light railways is approximately 268 miles, and the engineers' estimates amount to £1,432,192, so that the average estimated cost per mile is about £5344.

The Commissioners did not consider that the Deptford scheme (being entirely within the Metropolitan area) and the Taunton proposal (for a purely urban tramway) came within the scope of the Light Railways Act. The Echt Extension—completing the Echt Light Railway by connecting it with the main line at Kittybrewster in the northern suburb of Aberdeen—lies almost entirely in tunnel or deep cutting, and is, therefore, so costly and exceptional that it is omitted from the above calculation of the average cost per mile of the light railways for which applications were submitted in May 1897.

The motive power proposed for most of the fifty-six schemes which have been named is steam; for others it is merely described as "animal, electric, or other mechanical," "animal or electric," etc.; for three lines—the Isle of Thanet, Llandudno and Colwyn Bay, and Derby and Ashbourne—electricity was definitely named. The Derby and Ashbourne line will run alongside the highway—serving the Dovedale tourist traffic and tapping a rich agricultural district—and make an independent way within the town of Derby to reach the Great Northern Railway station.

The light railway from Helston to the Lizard will serve a large fishing industry, encourage tourist traffic, and bring the Cornish farmers' early vegetables and fruit to the great markets, tapping, as it will, an agricultural district capable of considerable development.

The proposal of the Great Western Railway Company, strongly supported by local opinion, to construct a light railway from Salisbury through the Avon Valley to Pewsey—and therefore passing over land acquired for military purposes—has been approved, and the Board of Trade have since confirmed an Order, although the scheme was at one time strongly opposed by the War Office.

Crowland, by means of the Lincolnshire and Northamptonshire scheme, will now have direct railway communication with Postland on the Spalding and March line, G.E.R., and Peakirk on the Peterborough and Spalding Loop, G.N.R.

Since the issue of the *Report of the Proceedings of the Board of Trade, under the Light Railways Act,* 1896, *during the period ending* 31*st December* 1897, *and of the Proceedings of the Light Railway Commissioners during the period ending* 22*nd November* 1897, applications for the following light railways have been approved by the Commissioners:—

	Miles.
Abergavenny and Monmouth,	12
Grimsby and Saltfleetly,	17½
Isle of Axholme,	22
Kinver,	4
Amesbury and Military Camp,	10¾
Middleton (Lancashire),	8¼
North Shields, Tynemouth, and District,	2
North Sunderland,	1½
Rochester, Chatham, and District,	14½
Isle of Sheppey,	7¾
Ventnor,	½
Bankfoot,	3
Coatbridge and Airdrie,	3
Barking and Becton,	1¼
Pewsey and Salisbury (Devizes Loop),	¼
Hanwell and Uxbridge,	7¼
Hampshire (Cosham and Hordean),	6
Poole and District,	7
South Norfolk,	17¾
Didcot and Wallington,	13¼
Derby and Ashbourne (additional powers),	2¼
Rochester, Chatham, and Gillingham (new lines),	1
Dundee and Broughty Ferry,	5¼
Maidens and Dunure (Ayr),	19½
Liverpool and Prescot,	3
Central Essex (partly),	19½
Bardfield and Sible Hedingham,	7¾
Merthyr Tydvil,	3¼
Kelvedon, Tiptree, and Tollesbury,	9¾
Kelvedon, Coggleshall, and Halsted (partly),	2

The total length of these 30 light railways is about 233 miles.

APPENDICES.

APPENDICES.

APPENDIX I.

COST OF RAILWAY CONSTRUCTION IN DIFFERENT COUNTRIES.

(From the Bulletin of the International Railway Congress, Vol. X., No. 7, July 1896.)

Numbers. 1	COUNTRIES. 2	Date to which Statistics apply. 3	Mileage at that Date. 4	Construction Capital.	
				Total. 5	Per Mile. 6
	I.—Europe.			£	£
1	Germany, ...	31. 3. 1895	27,433	559,043,150	20,411
2	Austria-Hungary, . .	31. 12. 1891	17,077	329,771,950	19,310
3	Great Britain and Ireland,	31. 12. 1894	20,904	985,387,350	47,138
4	France, ...	31. 12. 1894	22,499	617,517,550	27,446
5	Russia, ...	31. 12. 1892	18,441	326,564,650	17,708
6	Italy, ...	31. 12. 1890	6,493	154,221,650	23,752
7	Belgium (State Railways),	31. 12. 1893	2,038	55,368,800	27,168
8	Switzerland, . . .	31. 12. 1893	2,079	44,642,500	21,473
9	Spain, ...	31. 12. 1889	6,273	113,624,550	18,113
10	Netherlands, . . .	1887	1,630	27,734,600	17,015
11	Denmark (State Railways),	31. 3. 1892	947	9,543,000	10,077
12	Norway, ...	30. 6. 1894	1,001	7,593,000	7,584
13	Sweden (State Railways),	31. 12. 1894	1,900	16,051,650	8,448
14	Roumania (State Railways), . . .	31. 12. 1893	1,525	24,259,250	15,907
15	Servia, ...	1894	335	3,963,100	11,830
	Total, .	...	130,575	3,275,286,750	25,083
	II.—				
1	United States of America,	30. 6. 1894	176,568	2,267,259,500	12,840
2	Canada, . . .	30. 6. 1894	15,765	186,474,750	11,830
3	Brazil, ...	31. 12. 1891	6,388	61,119,250	9,567
4	Argentine Republic, .	1893	8,357	85,577,900	10,240
5	British India, . .	31. 12. 1893	18,455	226,331,500	12,263[*]
6	Java (State Railways), .	31. 12. 1893	607	6,206,850	10,225
7	Japan (State Railways), .	31. 3. 1894	978	11,310,800	11,564
8	Algiers and Tunis, .	31. 12. 1894	1,990	26,071,250	13,101
9	Cape Colony, . .	1. 1. 1894	2,228	20,092,300	9,018
10	New South Wales, .	30. 6. 1895	2,531	36,611,350	14,465
11	South Australia, . .	30. 6. 1895	1,722	12,529,400	7,386
12	Victoria, . . .	30. 6. 1895	3,119	37,922,200	12,158
13	Queensland, . . .	30. 6. 1895	2,378	16,522,300	6,527
14	West Australia, . .	30. 6. 1895	550	2,092,350	3,804
15	Tasmania, . . .	31. 12. 1894	419	3,518,600	8,397
16	New Zealand, . .	31. 3. 1895	1,993	15,352,600	7,101
	Total, .	...	244,048	3,014,983,900	12,354

Total for all Europe, . 152,427 × 25,083 = 3,823 million pounds.
For the rest of the world, 274,802 × 12,354 = 3,394 — —
Total for all the world, 427,224 × 16,900 = 7,217 millions.
Average cost per mile, £16,900.

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[*] Apparently ten rupees have been assumed to be equal to £1. Taking the rupee at about 16d., the cost would be £8175.

APPENDIX II. See Folding Table opposite.

APPENDIX III.

GROSS EARNINGS, EXPENSES, AND NET EARNINGS PER MILE PER WEEK, PAYING INTEREST ON A LINE COSTING 10,000 UNITS PER MILE.

Per Annum.		Working Expenses, taking, of Gross Earnings,—	Per Mile per Week in Units.		
Interest on Capital.	Net Earnings in Units.		Gross Earnings.	Expenses.	Net Earnings.
4 per cent.,	400	40 per cent.	12·8	5·1	7·7
		45 ,,	14·0	6·3	
		50 ,,	15·4	7·7	
		55 ,,	17·1	9·4	
4½ per cent.,	450	40 ,,	14·5	5·8	8·7
		45 ,,	15·8	7·1	
		50 ,,	17·4	8·7	
		55 ,,	19·3	10·6	
5 per cent.,	500	40 ,,	16·0	6·4	9·6
		45 ,,	17·5	7·9	
		50 ,,	19·2	9·6	
		55 ,,	21·3	11·7	
5½ per cent.,	550	40 ,,	17·7	7·1	10·6
		45 ,,	19·3	8·7	
		50 ,,	21·2	10·6	
		55 ,,	23·6	13·0	

APPENDIX IV. See Folding Table opposite.

RNS F

Gross] T Tota
£
81,396,
68,702,
9,286,
3,407,
4,150,
4,242,
8,911,
4,596,
11,568,
3,619,
2,587,
1,333,
2,226,
9,037,
7,059,
2,153,
3,
1,
17,
2,
21,
1,
4,
3,
2,
6,
9,
2,
5,

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[*To face p.* 282.

Total from all Sources.	k. riages, igons, ucks, etc.	Mean Mileage Open during the Year.	Mean Mileage Worked.	
Rx. 25,311,454	...	18,559	...	
18,834,780	...	10,693	...	
6,345,758	...	7,600	...	
130,916	...	265	...	
5,433,317	,579	1,651	1,858	State lines worked by companies.
669,065	3,831	861	862	
576,389	2,547	677	754	
3,371,835	2,148	2,439	2,618	State lines worked by the State.
1,051,884	,968	773	773	
1,483,591	2,580	248	938	
3,627,430	,635	1,490	1,490	Lines worked by guaranteed companies.
1,594,848	4,524	461	461	
325,689	887	355	355	Native state line worked by a company.
555,955	3,069	342 415	756	State lines worked by companies.
2,514,420	3,781	1,674	1,729	
...	...	213	...	
...	2,625	479 86	...	State line worked by the State.
143,158	840	54	279	Assisted company.
116,143	301	321 44	364	Lines owned and worked by native States.
199,584	1,121	334	380	
7,193	92	26	...	State line worked by the State.
63,628	249	51	...	Assisted company.
24,032	251	72	...	Native state line worked by a company.
4,028	34	22	...	Native state line worked by the State.
32,035	157	94	...	Line owned and worked by native State.

N.B.—Rx. (

APPENDIX V.

HALF-YEARLY STATISTICS OF INDIAN RAILWAYS, 1894.

HEADINGS.	East Indian.	Indian Midland.	Grand Indian Peninsula.	Bengal and North-Western.	Rajputana-Malwa.	Bhâvnagar-Gondal-Junâgarh-Porbandar.
Gauge of Railway,	5′ 6″	5′ 6″	5′ 6″	3′ $3\frac{3}{8}$″	3′ $3\frac{3}{8}$″	3′ $3\frac{3}{8}$″
Mean mileage worked, Miles	1844·67 1871·98	753·78 753·78	1490·08 1490·23	756·30 756·30	1674·02 1746·22	380·08 380·21
Inclination of steepest gradient,	$\frac{1}{40}$	$\frac{1}{80}$	$\frac{1}{37}$	$\frac{1}{200}$	$\frac{1}{40}$	$\frac{1}{67}$
Length of steepest gradient, Miles	3·98	2·40	5·85	3·42	3·40	0·07
Percentage of net earnings on capital outlay,	5·19 4·36	1·41 1·11	4·72 1·29	3·78 2·26	7·17 4·12	3·46 1·08
,, ,, paid-up capital,	...	1·38 1·10	4·69 1·28	...	...	...
Capital outlay per mile open, R	207,054 207,583	126,808 127,325	212,366 212,734	67,032 67,196	75,706 79,455	49,003 49,136
Total earnings per mile open per week, ,,	607 515	162 132	596 341	150 111	330 236	123 79
Total expenses ,, ,, ,,	186 164	93 78	260 242	54 54	113 103	58 58
Total earnings per train mile, ,,	5·19 4·73	3·84 3·56	4·37 3·39	3·36 2·68	3·67 3·32	3·64 3·22
Total expenses ,, ,, ,,	1·59 1·51	2·21 2·11	1·91 2·41	1·22 1·32	1·26 1·44	1·70 2·38
Net earnings ,, ,, ,,	3·60 3·22	1·63 1·45	2·46 0·98	2·14 1·36	2·41 1·88	1·94 0·84

***N.B.*—The bracketed figures are respectively for the 1st (January–June) and 2nd (July–December) half-years of 1894.**

HALF-YEARLY STATISTICS OF INDIAN RAILWAYS, 1894—(*continued*).

HEADINGS.	East Indian.	Indian Midland.	Grand Indian Peninsula.	Bengal and North-Western.	Rajputana-Malwa.	Bhâvnagar-Gondal-Junâgarh-Porbandar.
Percentage of total expenses on total earnings,	30·67	57·43	43·65	36·23	34·33	46·74
	31·86	59·18	71·18	49·15	43·43	73·82
Ditto (inclusive of steam-boat service),	30·75	57·43	43·65	36·50	34·33	46·74
	31·98	59·18	71·18	48·89	43·43	73·82
Coaching train-miles run,	2,224,237	344,410	1,826,491	364,995	1,069,854	162,073
	2,214,738	348,676	1,900,362	406,581	1,089,831	153,989
Average receipts for carrying a 1st class passenger one mile, Pies	15·48	11·17	11·05	20·51	13·68	10·72
	15·55	11·00	11·03	21·10	13·23	10·58
" " 2nd " " "	6·55	4·83	3·49	10·00	6·11	5·15
	6·49	4·47	4·29	9·83	5·97	5·11
" " 3rd " " "	3·52	2·99	3·00	4·83	3·00	...
	3·37	2·99	3·00	4·83	3·00	
" " 4th " " "	2·51	2·54	2·42	2·00	2·00	2·75
	2·51	2·54	2·40	2·00	2·00	2·75
Average number of passengers in a train,	281·54	189·11	163·05	282·01	274·56	219·79
	235·47	155·58	140·38	220·06	253·57	205·07
Average number of vehicles in a coaching train,	20·45	16·91	14·30	27·03	21·02	18·85
	19·91	15·80	13·94	23·60	20·84	16·69
Average weight of a coaching train, Freight, . Tons	19·54	14·03	12·05	17·76	18·62	14·30
	17·00	11·76	10·46	13·83	17·07	13·21

,, ,, ,, Dead weight,	,,	232·38 229·44	239·99 228·39	205·08 201·94	161·22 145·09	127·31 131·16	132·23 121·06
,, ,, ,, Total,	,,	251·92 246·44	254·02 240·15	217·13 212·40	178·98 158·92	145·93 148·23	146·53 134·27
Average cost of hauling a coaching train one mile,	R	1·01 0·99	1·60 1·60	1·37 1·92	0·92 1·05	0·79 0·99	1·45 2·06
,, ,, ,, vehicle ,,	Pies	10·65 10·76	20·53 22·33	21·19 30·59	6·99 9·25	8·20 10·43	17·32 27·91
,, ,, passenger one mile,	,,	0·63 0·73	1·45 1·75	1·41 2·29	0·61 0·89	0·51 0·70	1·21 1·84
Average profit on working a coaching train one mile,	R	3·37 2·81	1·64 1·17	1·29 0·45	2·35 1·51	2·58 2·12	2·05 1·17
,, ,, passenger one mile,	Pies	2·08 2·02	1·40 1·15	1·25 0·43	1·48 1·21	1·61 1·42	1·65 1·01
Goods train—miles run,		3,388,101 3,088,404	481,625 379,220	3,453,650 1,993,593	511,093 406,606	2,842,358 2,140,033	172,841 87,427
Average receipts for carrying a ton of goods one mile,	Pies	5·01 5·03	6·40 7·18	8·37 8·36	6·38 6·08	6·19 6·53	11·10 9·27
Average number of tons of goods in a train,		215·17 201·56	123·79 110·23	119·74 98·12	95·94 82·17	114·89 98·48	63·21 60·94
Average number of vehicles in a goods train,		33·11 30·67	29·36 25·34	24·25 22·95	28·19 25·47	25·11 24·91	26·78 24·84
Percentage of freight upon capacity hauled,		54·10 53·86	40·19 41·38	48·43 42·33	41·44 40·03	66·45 59·01	44·27 45·70
Average load of a goods vehicle (including loaded and empty),	Tons	6·67 6·76	4·49 4·68	5·36 4·67	3·61 3·45	4·75 4·09	2·43 2·50
Average load of a loaded goods vehicle,	,,	9·19 9·41	7·17 7·64	7·56 6·31	4·71 4·54	6·25 5·55	3·28 3·77
Average weight of a goods train, Freight,	,,	215·17 201·56	123·79 110·23	225·76 188·87	95·94 82·17	114·89 98·48	63·21 60·94

HALF-YEARLY STATISTICS OF INDIAN RAILWAYS, 1894—(*continued*).

HEADINGS.		East Indian.	Indian Midland.	Grand Indian Peninsula.	Bengal and North-Western.	Rajputana-Malwa.	Bhâvnagar-Gondal-Junâgarh-Porbandar.
Average weight of a goods train, Dead weight,	Tons	248·29 239·07	274·23 249·28	219·78 211·47	136·60 125·88	141·59 142·01	120·31 113·80
,, ,, ,, Total,	,,	463·46 440·63	398·02 359·51	339·52 309·59	232·54 208·05	256·48 240·49	183·52 174·74
Average cost of hauling a goods train one mile,	R	1·86 1·77	2·50 2·40	2·14 2·80	1·19 1·38	1·39 1·61	1·82 2·68
,, ,, ,, vehicle ,,	Pies	11·10 11·39	17·42 19·56	18·37 25·55	8·62 11·12	11·02 12·85	13·42 21·15
,, ,, one ton of goods one mile,	,,	1·66 1·68	3·88 4·18	3·43 5·47	2·38 3·22	2·32 3·14	5·53 8·44
Ditto (including interest on capital at 5 per cent.),	,,	3·55 3·84	8·05 9·59	5·84 9·62	5·63 7·42	3·91 5·69	10·24 15·65
Average profit on working a goods train one mile,	R	3·76 3·51	1·63 1·72	3·08 1·47	2·00 1·22	2·31 1·74	1·83 0·26
,, ,, ,, vehicle ,,	Pies	22·36 22·66	11·33 14·01	26·48 13·46	14·45 9·86	18·37 13·90	13·51 2·07
,, ,, one ton of goods one mile,	,,	3·35 3·35	2·52 3·00	4·94 2·89	4·00 2·86	3·87 3·39	5·57 0·83

PERCENTAGE OF WORKING EXPENSES ON TOTAL EARNINGS.						
Maintenance,	8·87	16·12	10·69	9·51	5·84	16·60
	8·72	12·39	19·81	12·27	6·92	25·93
Locomotive expenses,	8·00	16·98	17·07	7·40	15·03	12·73
	8·19	18·09	26·73	9·75	17·42	17·18
Carriage and wagon expenses,	2·29	3·90	3·70	1·94	3·26	2·40
	2·75	4·72	6·54	2·71	4·99	3·69
Traffic expenses,	5·29	7·84	6·95	6·77	5·44	9·06
	6·10	9·34	11·41	9·45	7·22	12·14
General charges,	3·23	7·76	3·00	6·37	4·29	7·93
	3·90	10·07	5·34	8·68	5·96	12·71
Miscellaneous expenses,	2·94	4·83	2·24	1·47	0·47	1·98
	2·13	4·57	1·35	2·29	0·92	2·17
Steam-boat expenses,	0·13	...	...	3·04	...	...
	0·19			3·74		
Total working expenses,	30·75	57·43	43·65	36·50	34·33	46·74
	31·98	59·18	71·18	48·89	43·43	73·82
MAINTENANCE AND RENEWAL OF PERMANENT-WAY.						
Per mile of line maintained, R	902·49	445·59	861·08	200·34	291·82	310·18
	714·10	204·25	827·59	164·95	208·93	313·99
Per mile of track, including sidings, "	600·50	392·06	578·30	177·82	258·58	279·96
	476·65	180·39	555·83	146·42	181·42	283·52
Per total train-mile, Annas	4·69	6·34	3·89	2·76	2·09	5·58
	3·98	3·30	5·07	2·45	1·84	2·07
Per 1000 gross ton-miles, R	0·77	1·17	0·82	0·82	0·58	2·10
	0·69	0·68	1·21	0·84	0·55	3·30

HALF-YEARLY STATISTICS OF INDIAN RAILWAYS, 1894—(*continued*).

HEADINGS.		East Indian.	Indian Midland.	Grand Indian Peninsula.	Bengal and North-Western.	Rajputana-Malwa.	Bhâvnagar-Gondal-Junâgarh-Porbandar.
LOCOMOTIVE EXPENSES.							
Per total train-mile, ...	Annas	6·66	10·43	11·93	4·31	8·80	7·41
		6·22	10·30	14·50	4·55	9·11	8·85
Average price per ton of coal, ...	R	1·89	10·25	12·53	6·31	17·60	20·11
		1·94	9·48	12·55	5·81	16·45	17·46
Coal consumed per train-mile, ...	lbs.	54·36	51·46	41·66	29·77	31·12	24·16
		52·94	46·22	42·83	28·38	32·53	26·13
CARRIAGE AND WAGON EXPENSES.							
Per total train-mile, ...	Annas	1·91	2·40	2·59	1·13	1·91	1·40
		2·09	2·69	3·55	1·27	2·65	1·90
TRAFFIC EXPENSES.							
Per total train-mile, ...	Annas	4·40	4·82	4·86	3·94	3·19	5·27
		4·63	5·32	6·19	4·41	3·83	6·25

GENERAL CHARGES.							
Per total train-mile,	Annas	2·69	4·77	2·10	3·71	2·51	4·62
		2·95	5·73	2·89	4·05	3·16	0·55
Average gross weight of trains, coaching,	Tons	169·04	156·48	156·73	196·24	102·67	57·27
		166·03	135·17	151·50	191·29	101·42	62·30
,, ,, ,, goods,	,,	439·81	337·62	280·87	183·67	216·38	161·83
		418·20	301·50	250·94	195·85	197·76	159·55
,, ,, ,, mixed,	,,	236·80	249·11	...	176·52	127·75	124·97
		220·02	256·38		147·78	126·42	120·56
Average through speed of trains, coaching,	Miles per hour	25·00	24·10	23·02	...	18·38	20·60
		25·00	22·80	22·87		18·38	20·60
,, ,, ,, goods,	,, ,,	12·20	11·25	10·98	11·00	9·18	10·69
		12·20	10·79	10·51	11·00	9·18	11·11
,, ,, ,, mixed,	,, ,,	17·48	14·86	15·19	12·15	13·80	12·26
		17·48	14·73	15·47	12·15	13·80	12·50
Average load of passengers,	Miles	63·95	69·81	42·41	36·07	53·91	35·45
		62·43	68·27	38·72	38·79	58·81	35·81
,, goods,	,,	221·89	170·05	241·32	110·51	271·90	77·57
		218·08	132·71	196·03	107·13	248·20	58·42
Total tonnage of goods lifted,	Tons	3,283,310	350,476	1,710,495	443,559	1,200,057	136,936
		2,850,422	314,895	993,726	311,684	846,833	87,040

APPENDIX VI.

EXTRACTS FROM THE NORTH-WESTERN RAILWAY'S COACHING TARIFF.

Schedule of Maximum and Minimum Fares and Rates for Coaching Traffic applicable to the North-Western Railway under the orders issued in the Government of India Resolution No. 563 R. T., dated the 16th July 1891, as modified by the Government of India Circular No. 11 Railway, dated the 14th December 1896.

Passenger Fares—	Maximum pies per mile.	Minimum pies per mile.
1st Class,	18	12
2nd Class,	9	6
Intermediate Class,	4½	3
3rd Class,	3	1

Carriages *—	Maximum pies per mile.	Minimum pies per mile.
Single Carriages,	42	30

	Maximum pies per truck.	Minimum pies per truck.
Two or more carriages on one truck,	54	42

Horses *—	Maximum pies per mile.	Minimum pies per mile.
Single Horse,	24	18

Dogs—	Maximum pies per fifty miles or portion thereof.	Minimum pies per fifty miles or portion thereof.
Each,	96	48

Luggage, Parcels, and Bullion—

The Rates passed at the Railway Traffic Conference of 1893, which are as under:—

Parcels and Luggage—

(*a*) Parcels shall be charged by either weight or measurement, whichever gives the greater charge, two cubic feet being considered equal to ten seers † in weight.

(*b*) Each parcel shall be charged for separately.

(*c*) Parcels not exceeding one cubic foot by measurement, or five seers in weight—

(i.) When the weight does not exceed two and a half seers, four annas per 500 miles, or fraction of 500 miles, subject to a maximum charge of one rupee.

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* Subject to a minimum *charge* of Rs. 5.

† 40 seers = 1 maund = 82·29 pounds.

When the weight does not exceed five seers, four annas per 250 miles or fraction of 250 miles, subject to a maximum charge of two rupees.

(*d*) Parcels exceeding one cubic foot in contents or five seers in weight shall be charged at the rates shown in the following table, provided that when lower rates than those shown in the table can be secured by re-booking at any station, it shall be optional with any Railway to charge the sum of the rates from the despatching station to such re-booking station, and from such re-booking station to destination :—

Rate List for Luggage and Parcels.

Distances in Miles.	Not exceeding 10 seers.	Exceeding 10 seers, but not exceeding 20 seers.	Exceeding 20 seers, but not exceeding 30 seers.	Exceeding 30 seers, but not exceeding 40 seers.	Additional charge for fractions in excess of even mds.
	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	
Not exceeding 25	0 4 0	0 4 0	0 4 0	0 4 0	The amounts entered in the respective columns.
Exceeding 25, but not exceeding 50	0 4 0	0 4 0	0 8 0	0 8 0	
" 50, " 100	0 4 0	0 8 0	0 12 0	1 0 0	
" 100, " 150	0 8 0	0 12 0	1 0 0	1 8 0	
" 150, " 300	0 8 0	1 0 0	1 8 0	2 0 0	
" 300, " 450	0 12 0	1 8 0	2 4 0	3 0 0	
" 450, " 600	1 0 0	2 0 0	3 0 0	4 0 0	
" 600, " 750	1 4 0	2 8 0	3 12 0	5 0 0	
" 750, " 900	1 6 0	2 12 0	4 2 0	5 8 0	
" 900, " 1,050	1 9 0	3 2 0	4 12 0	6 4 0	
" 1,050, " 1,200	1 12 0	3 8 0	5 6 0	7 2 0	
" 1,200, " 1,333	2 0 0	4 0 0	6 0 0	8 0 0	
" 1,333, " 1,500	2 4 0	4 8 0	6 12 0	9 0 0	
" 1,500, " 1,666	2 8 0	5 0 0	7 8 0	10 0 0	
" 1,666, " 1,833	2 12 0	5 8 0	8 4 0	11 0 0	
" 1,833, " 2,000	3 0 0	6 0 0	9 0 0	12 0 0	
" 2,000, " 2,166	3 4 0	6 8 0	9 12 0	13 0 0	
" 2,166, " 2,333	3 8 0	7 0 0	10 8 0	14 0 0	
" 2,333, " 2,500	3 12 0	7 8 0	11 4 0	15 0 0	
" 2,500, " 2,666	4 0 0	8 0 0	12 0 0	16 0 0	
" 2,666, " 2,833	4 4 0	8 8 0	12 12 0	17 0 0	
" 2,833, " 3,000	4 8 0	9 0 0	13 8 0	18 0 0	
For each additional 167 or part of 167 miles beyond 3000 miles .	0 4 0	0 8 0	0 12 0	1 0 0	

(*e*) Passengers' luggage, whether booked for conveyance by the same train in which the owner travels or not, shall be charged at the rates given in clause (*d*) by weight only ; and when booked by sender to self, shall be charged upon the gross weight of the total number of packages.

(*f*) Excess luggage and parcels containing perishable or dangerous goods shall be prepaid. The prepayment of parcels not containing perishable or dangerous goods shall be optional.

(*g*) Parcels exceeding forty seers in weight or 8 cubic feet in measurement shall be booked only if accommodation will allow.

(*h*) The charges for parcels and luggage shall be reckoned on the through distance as if it were one railway, with one minimum only, and shall be divided in mileage proportion.

(*i*) No charge shall be made to the public for the distance parcels are mis-sent through the fault of another railway.

PASSENGERS, CLASSES, AND FARES.

24. **Classes of Fares on N.-W. Railway.**—There are **four classes** of ordinary passenger accommodation on the North-Western Railway for which the fares * are as follows:—

	North-Western Railway generally.	Mushkaf-Bolan and Sind-Pishin Lines.
1st Class, . . .	1 anna per mile.	18 pies per mile.
2nd Class, . .	6 pies ,,	9 ,, ,,
Intermediate Class, .	3 ,, ,,	4½ ,, ,,
3rd Class, . . .	2¼ ,, ,,	3 ,, ,,

LUGGAGE RATES AND RULES.

99. **Passengers' Luggage and Free Allowance.**—On all railways all packages of whatever description (except specie or bullion, *vide* para. 162*k*) taken as passengers' luggage will be weighed, and the following quantities allowed free of charge:—

For each	1st Class passenger, . . .	60 seers.
,,	2nd ,, . . .	30 ,,
,,	Intermediate Class passenger, . .	20 ,,
,,	3rd Class passenger, . . .	15 ,,

Half the above quantity for a child's half ticket.

See also paras. 66 *d.* to *f.* and 103.

(*a*) On all railways, except I. M., R. and K., B. D., D. H., G. I. P., Nizam's, E. C., and Morvi Railways, rugs, umbrellas, sticks, tiffin baskets, and small hand bags, which 1st and 2nd class passengers usually take into the carriage with them for their requirements on the journey, are not weighed. Similarly, the rezai or blanket, which an intermediate or 3rd class passenger takes with him when travelling, is not weighed.

EXTRACTS FROM THE NORTH-WESTERN RAILWAY'S GOODS TARIFF.

Schedule of authorised Maxima and Minima Rates for Goods Traffic applicable to the N.-W. Railway under the orders issued by Government of India in Public Works Department Resolution No. 563 R.T., dated 16th July 1891, as modified by Government of India Circular No. 11 Railway, dated 14th December 1896.

Classes.	Pies per maund per mile.	
	Maximum.	Minimum.
5th, ...	1	$\frac{1}{6}$
4th, ...	$\frac{5}{6}$	
3rd, ...	$\frac{2}{3}$	
2nd, ...	$\frac{1}{2}$	
1st, ...	$\frac{1}{3}$	
Special, . . .	$\frac{1}{3}$	$\frac{1}{10}$
Explosives, . . .	$1\frac{1}{2}$	$\frac{1}{6}$

N.B.—One pie may be taken as one-twelfth of a penny, and one maund as 82·29 pounds avoirdupois (there being 27·22 maunds to 1 ton).

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* Referred to in Chap. VIII. p. 120.

GENERAL RULES.

3. Published Rates.—The rates quoted in the rate lists herein and in the printed sheets exhibited at stations, are from any one station to any other station, and are inclusive of all charges, except in special cases, where the railway is called upon to perform extra services. The rates can be ascertained from the goods rate tables published herein, or from the Station Masters; and from the Traffic Superintendent, Lahore, or the District Traffic Superintendents, Rawalpindi, Lahore, Sahàranpur, Mooltan, Sukkur, Quetta, and Kurrachee.

10. Risk-notes.—In all cases when goods or live-stock are conveyed at the risk of the owner, or on the understanding that the risk accepted by the railway is limited to any extent below the full value of the consignment, or the several sums prescribed in the Indian Railway Act of 1890, the consigner is required to execute a risk note prior to acceptance for despatch, on certain forms.

28. Loading and Unloading Charge.—In all cases where goods required to be loaded and unloaded by owners are handled by the railway, on account of the owners having failed to perform these duties, a charge of 3 pies per maund or more, as the case may be, will be made.

31. Minimum Weight Condition for Articles chargeable at Reduced Rates when consigned "in Full Wagon or Truck Loads."—In all cases, such as oil cake, mineral, class goods, lime, etc., in which reduced rates are quoted, subject to the condition that consignments should be "in full wagon or truck loads," such condition will be held to mean that consignments should be "in full wagon or truck loads of 300 mds. or over." When, however, a 10-ton vehicle is supplied, the minimum quantity for charge will be 270 mds.

32. Charges for Bogie Vehicles.—Double the ordinary rates will be charged for bogie vehicles in all cases in which wagon mile rates for ordinary stock are quoted.

RATES AND RULES FOR LOCAL AND THROUGH-BOOKING.

34. General Quotation of Rates.—The N.-W. Railway has through-booking arrangements with certain mentioned railways, all of which quote a rate per maund per mile.

35. Route by which Traffic should be booked.—Senders of goods, requiring them to be despatched by a particular route, must be required to make a note of such route on the consignment-note. In absence of such instructions, all traffic shall be booked, invoiced, and sent by the shortest route, provided it be the cheapest. But in cases where the N.-W. Railway has entire command of a route between the despatching and receiving stations, it may send the traffic by its own route, provided that the charge to the public does not exceed that by the shortest route.

36. Fixed Rates on N.-W. Railway.—Goods are conveyed on the North-Western Railway under different rates of freight according to their classification.

These rates * are as follows:—

Special	Class	Goods at	$\frac{1}{5}$ pie	per maund	per mile.
1st	,,	,,	$\frac{1}{3}$	,,	,,
2nd	,,	,,	$\frac{1}{2}$	,,	,,
3rd	,,	,,	$\frac{2}{3}$	,,	,,
4th	,,	,,	$\frac{5}{6}$	,,	,,
5th	,,	,,	1	,,	,,
Explosive or X		,,	$1\frac{1}{2}$ pies	,,	,,

37. Special Rates.—Besides these rates there are other special rates, which apply to several descriptions of goods when fulfilling certain specified conditions.

38. Terminal Charges in Local Traffic.—In local-booking, a terminal charge of 6 pies per maund is levied in addition to the mileage charge upon all consignments of 2nd, 3rd, 4th, 5th, and explosive class goods; and 3 pies per maund upon special and 1st class goods.

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* Referred to in Chap. VIII. p. 121.

39. **Terminal Charges in Through Traffic.**—In through-booking, with foreign lines, a terminal charge of 3 pies per maund is added to the actual mileage rates upon all classes of goods, except on cross traffic, *i.e.*, traffic passing through junctions.

40. **Special Terminal on Traffic between Kotri and Kurrachee City.**—In calculating rates for booking between Kotri (including Kotri-Bandar) and Kurrachee City or Kiamari 12 miles extra are added to the actual distance to and from Kotri, and rates calculated on the total distance. The rates shown in the Kurrachee rate list printed at page 489 include this extra charge.

NOTE.—In all other bookings charges will be calculated on the actual distance.

41. **Goods by Passenger Train.**—Goods required to be booked through by passenger train are charged at the parcels rate on all railways.

42. **Standard Weights.**—On Indian railways the following equivalents are used for Indian and English weights:—

10 seers = 20·57 lbs. Avoirdupois.
82·29 lbs. Avoirdupois = 1 md. (divided into 40 seers).
27·22 maunds = 1 ton.
100 ,, = 3·673 tons.

43. **Differential Charges.**—Except where otherwise specially provided when goods of the same description are charged at different rates according to distance or weight to be carried, the charge for the lesser distance or weight should never exceed the charge for the greater distance or weight, the lesser being included in the greater. This rule * applies also to certain other railways. On one or two railways it applies to weight only and not to distance, but on B. N. Railway, in case of wooden sleepers and timber, it applies to both, and on others the differential rule applies when specially notified as applying.

44. **Combined Rule.**—Except where otherwise specified, when in consequence of special rates to particular stations it may be cheaper to book goods to such stations, and thence to re-book at classified rates to destination, than it would be to book direct at classified rates, then the charge will be made at the special and classified rates combined, unless under the operation of the differential rule a lower charge may be in force.

NOTE.—This rule also obtains on certain other railways. On two it applies when specially notified to be combined. On one it applies to weight only.

MINIMA CHARGES AND METHOD OF CALCULATING FREIGHT.

61. **Minima Charges.**—The following general rules as to charges for maxima and minima weight and distances are adopted on all railways:—

I. **Minimum Weight accepted as Goods.**—The minimum weight of any consignment to be despatched by goods trains will be 14 seers, but packages of less weight may be despatched when forming part of a consignment of 14 seers or more, the railway reserving the right to refuse any article under 14 seers which may be considered unfit to be carried by goods trains.

(*a*) If a consignment consisting of a single package weighing less than 14 seers is tendered for despatch by goods train, it will be refused as *goods*, but will be accepted with the consent of the consigner as a *parcel*, and booked as such by passenger train.

II. **Distance.**—The minimum distance for freight charge will be 10 miles.

III. **Charge.**—The minimum charge will be 10 annas.

IV. **Weight.**—The minimum weight for charge is ½ a maund.

V. **Fractions.**—Subject to the minimum charge, fractions of ¼ maund are charged for as ¼ maund, but subject to Rules I. and V. (*a*), thus:—

14 seers are charged for as ½ maund.
26 ,, ,, ¾ ,,
121 ,, ,, 3¼ maunds, and so on.

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* Referred to in Chap. II. p. 14.

MINERALS.

113. Mineral Class Goods on N.-W. Railway.—All mineral class goods (other than coal, coke, and patent fuel) consigned in full wagon or truck loads (see para. 31) will be carried at the following rates according to the distance they are carried over the North-Western Railway :—

$\frac{1}{3}$ pie per maund per mile for distances below 100 miles.	Subject to the differential rule.
$\frac{1}{4}$ pie per maund per mile for distances over 100 miles and below 300 miles.	
$\frac{1}{5}$ pie per maund per mile for distances 300 miles & above.	

Owners to load and unload. If the railway has to do this, 3 pies per maund will be charged for each operation.

Minerals packed in bags in smaller quantities, 1st class rate on actual weight for the distance carried.

NOTE.—Minerals unpacked in smaller quantities will not be accepted for carriage over the N.-W. Railway.

Minerals charged at the 1st class rate will be loaded and unloaded by the railway.

RATES AND CONDITIONS FOR THE CARRIAGE OF COAL, COKE, AND PATENT FUEL FOR THE GENERAL PUBLIC.

122. Rates and Conditions for the Carriage of Coal, &c., for the General Public.—The following will be the scale of charges for the carriage, over the North-Western Railway, of coal, including coke and patent fuel, for the general public applicable alike to local and through traffic.

When this traffic is booked over railways whose administrations have not adopted these rates, the through rates with such railways shall be the sum of the local rates, the local rates of the railways parties to this arrangement being the charges according to this tariff to or from the junction stations of the railway or railways which have not accepted this schedule.

(*a*) *Consignments of less than a wagon load*—

These consignments will be charged for as a full wagon load at the rates shown below, unless the coal is bagged, in which case it will be charged at $\frac{1}{3}$ pie per maund mile on actual weight, subject to the differential rule, and carried at owner's risk.

(*b*) *Consignments in full wagon loads*—

	Per maund per mile.
For all distances up to 400 miles inclusive, .	. 0·15 pie.
For distance above 400 miles—	
For the first 400 miles, . . .	. 0·15 ,,
For the distance in excess of 400 miles, .	. 0·10 ,,

126. Rebate on Aggregate of Consignments carried a less Distance than 500 Miles.—At the end of any calendar half-year a consignee, whose aggregate consignments to one station or *via* one junction during the half-year shall have exceeded 50,000 maunds, may claim a refund in respect of the payments made in accordance with the following scale :—

On quantities in excess of—

Mds.		Mds.	Rebates.
50,000	up to	200,000, . .	2½ per cent.
200,000	,,	400,000, . .	5 ,,
400,000	,,	600,000, . .	7½ ,,
600,000	,,	800,000, . .	10 ,,
800,000		. . . .	15 ,,

The rebate under this scale will be limited to 10 per cent. of the total quantity carried.

127. **Rebate on Aggregate of Consignments carried 500 Miles and more over the Home Line.**—At the end of any calendar half-year a consignee, whose aggregate consignments to one station or *via* one junction during the half-year shall have exceeded 50,000 maunds, may claim a refund in respect of the payments made in accordance with the following scale:—

On quantities in excess of—

Mds.		Mds.	Rebate.
50,000	up to	200,000	2½ per cent.
200,000	,,	400,000	5 ,,
400,000	,,	600,000	7½ ,,
600,000	,,		25 ,,

The rebate under this scale will be limited to 15 per cent. of the total quantity of coal carried.

129. All charges for loading and unloading coal into and from railway wagons, as well as those for transhipment at ferries, or otherwise, shall be at the entire cost of the consigners and consignees, and will be in addition to the rates herein prescribed.

When it is necessary for the railway to load or unload, a charge of 3 pies per maund will be made for each operation.

APPENDIX VII.

No. 514 R. C. of 1896.

GOVERNMENT OF INDIA.

PUBLIC WORKS DEPARTMENT.

RAILWAY CONSTRUCTION.

Simla, the 17*th April* 1896.

Terms on which the Government of India are prepared to consider offers for the construction by the agency of private companies of branch lines forming feeders either to State lines worked by the State or to railways worked by companies.

Read—

Public Works Department Resolution No. 924 R. C., dated 15th September 1893.

Also Public Works Department Resolution, dated 29th March 1895.

OBSERVATIONS.—Many of the applications made under the above Resolutions show that the terms for the construction of branch or feeder lines of railway have not been fully understood.

The Government of India have accordingly resolved to cancel the previous Resolutions above quoted upon this subject and to issue a fresh Resolution embodying a summary of the concessions which (the previous assent of any railway company concerned having been first obtained) they are now prepared to give for the construction of branch or feeder railways; such concessions being usually confined to lines not exceeding 100 miles in length.

2. It should be clearly understood that these concessions are not applicable to the larger or more important railways or to mountain branches, for which separate negotiations are in all cases necessary.

RESOLUTION.—Branch lines forming feeders, whether to State lines worked by the State or to railways worked by companies, will ordinarily be made by the main line administrations, who shall have a prior right to construct them.

The Government of India will from time to time publish a list of branch lines for the construction of which they are prepared to receive tenders.

They will consider and dispose of any application for the inclusion in the said list of any other line which can properly be described as a branch or feeder line, and which does not, except in special circumstances, exceed 100 miles in length.

2. Proposals for the construction of branch lines under this Resolution must conform to the following terms and conditions:

(i.) Applicants must satisfy the Government that they are in a position to command substantial financial support.

(ii.) The gauge to be adopted must be approved by the Government in each case.

(iii.) The proposed railway shall be subject to the provisions of all Acts of the legislature applicable to Indian railways.

(iv.) The proposed railway shall be built in accordance with the fixed and moving dimensions for the time being prescribed by the Governor-General in Council, and on plans and estimates that have been approved by that authority. The route of the line, the situation of stations, and other similar details, shall be subject to approval by the Government.

(v.) The line, while under construction, shall be inspected when and so often as an inspecting officer appointed for that purpose by the Government may consider desirable with a view to ensure the construction of the line up to the standard agreed upon.

(vi.) Inasmuch as these railways are chiefly required for the development of country hitherto deficient in means of communication, and the anticipated profits may not therefore at once be fully realised, the Government of India are prepared to give financial assistance as set forth below. Proposals for financial concessions may be made in one or other of the following alternative forms:

(*a*) It may be stipulated that after the opening of the railway for traffic the Government shall guarantee out of the revenues of India a fixed yearly minimum dividend in rupees on the actual expenditure charged in the capital account of the branch railway company as entered in rupees in the company's books in India, with such share of the surplus net profits as may be agreed upon. The minimum dividend to be guaranteed in each particular case will depend upon consideration of the circumstances, but for the present no offer will be entertained that requires a guarantee exceeding 3 per cent.; or

Under (*a*) the company will receive an absolute guarantee of interest at a rate not exceeding 3 per cent. and a higher return if the net earnings of the branch are sufficient to pay more than the guaranteed dividend.

(*b*) It may be provided that a payment be made to the branch company by the main line to the extent necessary, together with the branch company's share of branch earnings [see section (6) of paragraph 3] to give the branch company a dividend of 3½ per cent. per annum on the actual expenditure charged in the capital account of the branch railway company as entered in rupees in the company's books in India; provided always that the payment so made to the branch company shall in no case exceed the net earnings of the main line from traffic interchanged with the branch. This rebate will be granted from the first earnings of revenue by the branch, such payment being calculated at the close of the year, payments on account, however, subject to adjustment, being permissible at the close of the first-half of each year. The net earnings of the main line from traffic interchanged with the branch are assumed to bear the same proportion to the gross earnings of the main line from such traffic as the net earnings of the whole system including the branch bear to the gross earnings thereof. If the net earnings of the branch line equal or exceed 3½ per cent. on the actual expenditure as above, the whole of such earnings will go to the branch company.

Under (*b*) the company will receive a dividend of 3½ per cent. provided that the amount of the net earnings from local and interchanged traffic be sufficient, and a higher return if the net earnings of the branch from its own traffic be sufficient to pay a higher dividend.

In either of the above cases (*a*) or (*b*) if the capital is raised in sterling, the capital to be entered in rupees in the company's books in India shall be the actual amount realised in rupees from time to time by the several remittances of funds to provide for expenditure in India, together with the sterling outlay from time to time in England converted into rupees at the average rate of exchange obtained by the Secretary of State for his remittances during the half-year preceding that in which the outlay shall have been incurred, and the capital expenditure in rupees on which the interest is from time to time to be calculated for the purposes of the guarantee or rebate, as the case may be, shall be the total outlay whether in India or England, up to any such time as thereto charged.

(vii.) The general character of the supervision and control that will be exercised by the Government over the branch railway, apart from the provisions of the Railways Acts and the preceding provisions of this Resolution, shall be as follows:

(*a*) No capital expenditure by the branch railway company will be allowed as between the Secretary of State and the company unless the prior sanction of the Secretary of State shall have been obtained. The company shall have no power to increase its share or stock capital without the sanction of the Secretary of State, or to borrow money except within a fixed limit and on specified conditions.

(*b*) The branch railway company, if required, shall keep capital accounts and statistics in forms approved by the Secretary of State; and shall render, free of cost, all accounts and statistics required by the Government. The accounts and books will be subject to audit on behalf of Government.

(viii.) Funds for the execution of new works, properly chargeable to capital, found necessary after the branch railway has been opened to public traffic shall be provided by the branch railway company. Such works and their cost shall be agreed upon between the branch railway company and the main line administration before they are put in hand. In the event of any difference of opinion arising between the branch railway company and the main line administration as to the necessity for and the cost of any new work, the matter shall be referred to the Director General of Railways as arbitrator, and his decision shall be final.

(ix.) The rates and arrangements in force on State railways in the matter of services rendered to all Departments of the State shall apply.

3. The following are the principal additional concessions admissible for branch or feeder railways for the construction of which tenders may be invited:

(1) The Secretary of State for India in Council, or the Government of India, respectively, will permit the charge of interest at a rate to be agreed upon in each case, during construction to the capital account of the railway under the terms of the Indian Railways Act of 1894 (57 and 58 Vict., Chapter 12), or the Indian Railway Companies Act X of 1895.

(2) The land required for the construction of the branch railway will be provided free of cost. Such grant shall not include land required for quarrying, ballast, brickfields, and kindred purposes.

(3) Electric telegraphs and telegraphic appliances will be supplied and maintained by the Government of India at the usual charges for such works.

(4) The results of existing surveys will be made available free of charge. When desired, fresh surveys will be made by the Public Works Department of the Government of India of any branch railway on the applicants depositing the estimated cost thereof in a Government Treasury, on the understanding that no preferential claim to a concession is thereby established. If permission be eventually given for the construction of the line, the actual cost of all such surveys, as well as of those made at the cost of Government, may be included in the capital cost of the railway. No responsibility will be accepted by Government for the accuracy of any survey, plan, estimate, or other information supplied.

(5) The branch railway may be constructed by the main line administration, and will be maintained and worked by that administration during the full currency of the contract to be entered into for the purpose, at a fixed ratio of expenses to earnings in each half-year. The ratio will, when the branch railway is of the same gauge as that of the working railway, usually be that obtaining on the whole system as from time to time existing, including the branch railway, but will not exceed 50 per cent. of the gross earnings of the branch from all sources, and will be inclusive of charges for the use of the main line rolling-stock.

(6) Such expenses on account of the Board of Direction of the Branch Line Railway Company as may be incurred with the sanction of the Secretary of State may be charged—

(*a*) during construction to the Capital Account of the Branch Line Company;

(*b*) after opening, and until the minimum dividend under paragraph 2 (vi.) (*a*) or (*b*) is received by the Branch Line Company, as part of the working expenses to be met out of the stipulated percentage of the earnings of the branch taken by the working railway;

(*c*) and thereafter out of the general receipts of the Branch Line Company.

(7) Railway materials for the branch railway will be carried over State lines at the special rates prescribed for such materials belonging to State railways.

4. The Government of India reserve the right to purchase all such branch railways at the expiry of 21 years, or at subsequent intervals of 10 years on 12 months' notice, the purchase price being 25 times the yearly average net earnings not including rebate payments, of the 3 years preceding the purchase, with a maximum price of 120 and a minimum of 100 per cent. of cost price on a rupee basis.

5. The Government also reserve—

(i.) The right to fix and vary from time to time the classification of goods, and maximum and minimum rates for each class of goods, as well as of passengers; and

(ii.) a general control in respect to the number and timing of trains.

6. Applications for concessions to construct branch railways under the terms of this Resolution should be submitted, in the form prescribed by Memorandum A, hereto attached, to the address of the Secretary to the Government of India, Public Works Department.

7. Applications for fresh surveys to be carried out on the terms detailed in conditions 3 (4) above should be submitted in the manner prescribed by Memorandum B, hereto attached, to the address of the Secretary to the Government of India, Public Works Department.

The Governments of Madras, Bombay, Bengal, the North-Western Provinces and Oudh, and the Punjab.
The Chief Commissioners of the Central Provinces, Burma, and Assam.
The Resident at Hyderabad.
The resident in Mysore.
The Agents to the Governor General in Central India, Rajputana, and Baluchistan.
The Director General of Railways.
The Consulting Engineers to the Government of India for Railways, Calcutta, Lucknow, and Assam.
The Accountant General, Public Works Department.

ORDER.—Ordered that this Resolution be forwarded for information to the Local Governments and Administrations and to the officers marginally noted.

Also that it be published for general information in the *Gazette of India.*

W. S. S. BISSET, *Col., R.E.,*
Secretary to the Government of India.

Documents Accompanying.

Enclosure No. 1.—Memorandum A for the guidance of persons or syndicates desirous of submitting proposals for the construction of branch or feeder railways, with form A and appendices A, B, and C.

Enclosure No. 2.—Memorandum B for the guidance of persons or syndicates desirous of having surveys made for branch or feeder lines of railway at their expense by the Public Works Department.

Enclosure No. I. (with Form A and Appendices A, B, and C) to Government of India Resolution No. 514 R. C. of 1896.

MEMORANDUM A.

For the guidance of persons or syndicates desirous of submitting proposals for the construction of branch railways in India forming feeders either to State lines worked by the State or to railways worked by companies.

1. All applications for leave to construct a branch or feeder railway in any part of British India are to be addressed to the Secretary to the Government of India, Public Works Department.

2. All such applications shall be printed, and shall be drawn up, as far as may be, in Form A, attached hereto, and shall specify—

(*a*) the company, person, or syndicate by whom the application is preferred; the proposed amount of capital, the number of shares, and the amount of each share;

(*b*) all the termini, together with the names of all the principal towns from, through, into, or near which the railway is intended to be constructed, as well as the names of each civil division and district to be traversed by the proposed alignment;

(*c*) the length, so far as known, of the proposed railway;

(*d*) the gauge, the weight of rails, etc.;

(*e*) the motive power to be employed;

(*f*) the maximum tolls, rates, and fares proposed to be charged on the projected railway;

(*g*) the proposals for working the railway when constructed; and if any agreement is under contemplation, or has been provisionally arranged with any existing Railway Administration under which the proposed line, when constructed, is to be leased out for working by such Railway Administration, the exact nature and terms of such agreement;

(*h*) any further information that may be required to enable Government to thoroughly understand the scope of the proposals.

3. Every such application shall be accompanied by a map to a scale of 1 mile to 1 inch, with the line of the proposed railway delineated thereon, so as to show its general course and direction, and also by an estimate as correct as may be of the works proposed to be authorised.

4. When the applicants draw up their own detailed plans and estimates, these documents are invariably to be prepared in strict accordance with the Rules for the preparation of railway projects issued under the authority of the Government of India, of which copies may be obtained on payment from the Superintendent of Government Printing, Calcutta.

5. Lists will be published from time to time of the branch railways forming feeders, whether to State lines worked by the State or to railways worked by companies, for the construction of which the Government of India are prepared to receive tenders. Copies of such lists can be obtained on application addressed to the Secretary to the Government of India, Public Works Department.

6. Upon written application to the Director General of Railways, permission will also be accorded to inspect, at all reasonable hours, the detailed plans, sections, and estimates at the disposal of Government in regard to any particular route already surveyed, provided that they relate to branch railways the construction of which the Government is prepared to entrust to companies; and copies of such plans, sections, and estimates will be furnished on payment of the cost of copying.

7. But in regard to all such information, statistics, plans, sections, or estimates, which may be furnished, it is to be recognised that the information thus offered to any person interested in the matter is simply the best information of the kind at the disposal of Government, and that Government cannot accept any responsibility whatever in regard to the accuracy of any of the documents.

FORM A.

To accompany all applications for leave to construct a branch or feeder railway in any part of British India.

	Nature of particulars to be specified.	Particulars.
1	The name of the Company, person, or persons by whom the application is preferred; the proposed amount of capital, the number of shares, and the amount of each share.	
2	The termini, together with the names of all the principal towns from, in, through, or into, or near which the railway is intended to be constructed.	*Reference to an Appendix* (vide *Appendix A*) *may be here given if necessary.*
3	The length, as far as known, of the proposed railway.	
4	The gauge proposed and weight of rails, &c.	
5	The motive power to be employed.	
6	The maximum tolls, rates, and fares intended to be charged on the proposed railway.	*Reference to an Appendix* (vide *Appendix B*) *may be here given if necessary.*
7	Details of any agreement which may have been provisionally arranged, or which it is desired to enter into, under which the proposed line, when constructed, is to be leased out for working to any existing Railway Administration.	*Reference to an Appendix* (vide *Appendix C*) *may be here given if necessary.*
8	Any further information that may be required to enable the Government of India to thoroughly understand the scope of the proposals.	

APPENDIX A.

ALIGNMENT OF PROPOSED BRANCH RAILWAY.

From ________ to ________

Principal towns and districts or provinces through which the projected railway will pass.

Towns.	Districts or Provinces.

FORM

To accompany all applications for leave t
in any part of I

	Nature of particulars to be specified.
1	The name of the Company, person, persons by whom the application preferred; the proposed amount capital, the number of shares, a the amount of each share.
2	The termini, together with the na of all the principal towns from, through, or into, or near which railway is intended to be construct
3	The length, as far as known, of proposed railway.
4	The gauge proposed and weight of rai &c.
5	The motive power to be employed.
6	The maximum tolls, rates, and far intended to be charged on the proposed railway.
7	Details of any agreement which may have been provisionally arranged, or which it is desired to enter into, under which the proposed line, when constructed, is to be leased out for working to any existing Railway Administration.
8	Any further information that may be required to enable the Government of India to thoroughly understand the scope of the proposals.

APPENDIX C.

Working of proposed branch railway.

has yet been arranged with any existing Railway Administration projected branch railway is to be worked ; but, when completed, offer the working to the Railway Company terms :—

Or

provisionally arranged with the Railway work the projected branch railway, when completed, on the follow-

, &c.

APPENDIX B.

Schedule of maximum and minimum rates and fares intended to be charged on the proposed branch railway.

	Maximum. Pies per mile.	Minimum. Pies per mile.
Passenger Fares—		
1st class,	...	...
2nd class,	...	...
Intermediate class,	...	...
3rd or lowest class,	...	...

	Maximum. Pies per maund per mile.	Minimum. Pies per maund per mile.
Luggage,	...	...

	Maximum. Pies per mile.	Minimum. Pies per mile.
Carriages—		
Single carriage,	...	...

	Maximum. Pies per truck.	Minimum. Pies per truck.
Two or more carriages on one truck,	...	...

	Maximum. Pies per mile.	Minimum. Pies per mile.
Horses—		
Single horse,	...	...

	Maximum. Pies per 50 miles or portion thereof.	Minimum. Pies per 50 miles or portion thereof.
Dogs—		
Each,	...	...

	First 100 miles. Annas.	Every additional 100 miles. Annas.
Parcels—		
Not exceeding 5 seers or 1 cubic foot,	...	...
,, ,, 10 ,, 2 cubic feet,	...	...
,, ,, 20 ,, 4 ,,	...	...
,, ,, 30 ,, 6 ,,	...	...
,, ,, 40 ,, 8 ,,	...	...
For every additional 10 seers or 2 cubic feet, or portion of 10 seers or 2 cubic feet,	...	...

	Maximum. Pies per maund per mile.	Minimum. Pies per maund per mile.
Goods rates—		
5th class,	...	...
4th ,,	...	...
3rd ,,	...	...
2nd ,,	...	...
1st ,,	...	...
Coal, edible grain, and other low-priced staples to be carried at special rates,	...	...

APPENDIX C.

Working of proposed branch railway.

No agreement has yet been arranged with any existing Railway Administration under which the projected branch railway is to be worked; but, when completed, it is proposed to offer the working to the _ Railway Company on the following terms:—

(i.) ____________________

(ii.) ____________________

(iii.), &c. ____________________

Or

It has been provisionally arranged with the ______ Railway Company to work the projected branch railway, when completed, on the following terms:—

(i.) ____________________

(ii.) ____________________

(iii.), &c. ____________________

Enclosure No. II. to Government of India Resolution No. 514 R. C. of 1896.

MEMORANDUM B.

For the guidance of persons or syndicates desirous of having surveys for branch or feeder lines of railway in India carried out at their expense by the Public Works Department.

1. All applications for the survey of proposed branch or feeder railway routes in any part of British India are to be addressed to the Secretary to the Government of India, Public Works Department.

2. All such applications shall specify—

(*a*) the company, person, or syndicate by whom the application is preferred;

(*b*) all the termini, together with the names of all the principal towns from, through, into, or near which the survey is intended to be carried, as well as the names of each civil division and district to be traversed by the proposed alignment;

(*c*) the length, so far as known, of the proposed railway;

(*d*) the gauge and the motive power to be employed;

(*e*) the intentions of the applicants as to the construction and working of the railway. If it is intended that the working shall be leased to any existing Railway Administration, the nature of the contemplated agreement shall be specified.

3. Every such application shall be accompanied by a map to a scale of 1 mile to 1 inch, with the line of the proposed survey delineated thereon, so as to show its general course and direction.

4. If the detailed plans and estimates are submitted to Government, these documents are invariably to be prepared in strict accordance with the Rules for the preparation of railway projects issued under the authority of the Government of India, of which copies may be obtained on payment from the Superintendent of Government Printing, Calcutta.

5. Upon written application to the Director General of Railways permission will also be accorded to inspect at all reasonable hours the detailed plans, sections, and estimates at the disposal of Government in regard to any particular route already surveyed, provided that they relate to branch or feeder railways, the construction of which the Government is prepared to entrust to companies; and copies of such plans, sections, and estimates will be furnished on payment of the cost of copying.

6. But in regard to all such information, statistics, plans, sections, or estimates, which may be furnished, it is to be recognised that the information thus offered to any person interested in the matter is simply the best information of the kind at the disposal of Government, and that Government cannot accept any responsibility whatever in regard to the accuracy of any of the documents.

APPENDIX VIII.

LIGHT RAILWAYS ACT, 1896.
[59 & 60 VICT. CH. 48.]

ARRANGEMENT OF SECTIONS.

Section.

1. Establishment of Light Railway Commission.
2. Application for orders authorising light railways.
3. Powers of local authorities under order.
4. Loans by Treasury.
5. Special advances by Treasury.
6. Limitation on amount of advance and provision of money by National Debt Commissioners.
7. Consideration of application by Light Railway Commissioners.
8. Submission of order to Board of Trade for confirmation.
9. Consideration of order by Board of Trade.
10. Confirmation of order by Board of Trade.
11. Provisions which may be made by the Order.
12. Application of general Railway Acts.
13. Mode of settling purchase money and compensation for taking of land.
14. Payment of purchase money or compensation.
15. Provisions as to Board of Trade.
16. Expenses of local authorities.
17. Joint committees.
18. Working of ordinary railway as light railway.
19. Power of owners to grant land or advance money for a light railway.
20. Power to grant Crown lands.
21. Provision as to Commons.
22. Preservation of scenery and objects of historical interest.
23. Junctions with existing railways.
24. Amendment of order.
25. Provision as to telegraphs.
26. Application to Scotland.
27. Extent of Act.
28. Definitions.
29. Short title.

SCHEDULES.

CHAPTER XLVIII.

An Act to facilitate the Construction of Light Railways in Great Britain.
[14th August 1896.]

BE it enacted by the Queen's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—

1. **Establishment of Light Railway Commission.**—(1) For the purpose of facilitating the construction and working of light railways in Great Britain, there shall be established a Commission, consisting of three Commissioners, to be styled the Light Railway Commissioners, and to be appointed by the President of the Board of Trade.

(2) It shall be the duty of the Light Railway Commissioners to carry this Act into effect, and to offer, so far as they are able, every facility for considering and maturing proposals to construct light railways.

(3) If a vacancy occurs in the office of any of the Light Railway Commissioners by reason of death, resignation, incapacity, or otherwise, the President of the Board of Trade may appoint some other person to fill the vacancy, and so from time to time as occasion may require.

(4) There shall be paid to one of the Commissioners such salary, not exceeding one thousand pounds a year, as the Treasury may direct.

(5) The Board of Trade may, with the consent of the Treasury as to number and remuneration, appoint and employ such number of officers and persons as they think necessary for the purpose of the execution of the duties of the Light Railway Commissioners under this Act, and may remove any officer or person so appointed or employed.

(6) The said salary and remuneration, and all expenses of the Light Railway Commissioners, incurred with the sanction of the Treasury in the execution of this Act shall, except so far as provision is made for their payment by or under this Act, be paid out of moneys provided by Parliament.

(7) The Commissioners may act by any two of their number.

(8) The powers of the Light Railway Commissioners shall, unless continued by Parliament, cease on the thirty-first day of December one thousand nine hundred and one.

2. **Application for orders authorising light railways.**—An application for an order authorising a light railway under this Act shall be made to the Light Railway Commissioners, and may be made—

(*a*) by the council of any county, borough, or district, through any part of which the proposed railway is to pass; or

(*b*) by any individual, corporation, or company; or

(*c*) jointly by any such councils, individuals, corporations, or companies.

3. **Powers of local authorities under order.**—(1) The council of any county, borough, or district, may, if authorised by an order under this Act—

(*a*) undertake themselves to construct and work, or to contract for the construction or working of, the light railway authorised;

(*b*) advance to a light railway company, either by way of loan or as part of the share capital of the company, or partly in one way and partly in the other, any amount authorised by the order;

(*c*) join any other council or any person or body of persons in doing any of the things above mentioned; and

(*d*) do any such other act incidental to any of the things above mentioned as may be authorised by the order.

(2) Provided that—

(*a*) an order authorising a council to undertake to construct and work or to contract for the construction or working of a light railway, or to advance money to a light railway company, shall not be made except on an application by the council made in pursuance of a special resolution passed in manner directed by the First Schedule to this Act; and

(*b*) a council shall not construct or work or contract for the construction or working of any light railway wholly or partly outside their area, or advance any money for the purpose of any such railway, except jointly with the council of the outside area, or on proof to the satisfaction of the Board of Trade that such construction, working, or advance is expedient in the interests of the area of the first-mentioned council, and in the event of their being authorised so to do their expenditure shall be so limited by the order as not to exceed such amount as will, in the opinion of the Board of Trade, bear due proportion to the benefit which may be expected to accrue to their area from the construction or working of the railway.

4. **Loans by Treasury.**—(1) Where the council of any county, borough, or district have advanced or agreed to advance any sum to a light railway company, the Treasury may also agree to make an advance to the company by lending them any sum not exceeding one quarter of the total amount required for the purpose of the light railway, and not exceeding the amount for the time being advanced by the council.

Provided that the Treasury shall not advance money to a light railway company under this section, unless at least one-half of the total amount required for the purpose of the light railway is provided by means of share capital, and at least one-half of that share capital has been subscribed and paid up by persons other than local authorities.

(2) Any loan under this section shall bear interest at such rate not less than three pounds two shillings and sixpence per centum per annum, as the Treasury may from time to time authorise as being in their opinion sufficient to enable such loans to be made without loss to the Exchequer, and shall be advanced on such conditions as the Treasury determine.

(3) Where the Treasury advance money to a light railway company under this section, and the advance by the council to the company is made in whole or part by means of a loan, the loan by the Treasury under this section shall rank *pari passu* with the loan by the council.

5. **Special advances by Treasury.**—(1) Where it is certified to the Treasury by the Board of Agriculture that the making of any light railway under this Act would benefit agriculture in any district, or by the Board of Trade that by the making of any such railway a necessary means of communication would be established between a fishing harbour or fishing village and a market, or that such railway is necessary for the development of or maintenance of some definite industry, but that owing to the exceptional circumstances of the district the railway would not be constructed without special assistance from the State, and the Treasury are satisfied that a railway company existing at the time will construct and work the railway if an advance is made by the Treasury under this section, the Treasury may, subject to the limitation of this Act as to the amount to be expended for the purpose of special advances, agree that the railway be aided out of public money by a special advance under this section.

Provided that—

(*a*) the Treasury shall not make any such special advance unless they are satisfied that landowners, local authorities, and other persons locally interested have by the free grant of land or otherwise given all reasonable assistance and facilities in their power for the construction of the railway; and

(*b*) a special advance shall not in any case exceed such portion not exceeding one-half of the total amount required for the construction of the railway as may be prescribed by rules to be made by the Treasury under this Act; and

(*c*) where the Treasury agree to make any such special advance as a free grant, the order authorising the railway may make provision as regards any parish that, during a period not exceeding ten years, to be fixed by the order, so much of the railway as is in that parish shall not be assessed to any local rate at a higher value than that at which the land occupied by the railway would have been assessed if it had remained in the condition in which it was immediately before it was acquired for the purpose of the railway, but before such provision is made in any order the local and rating authorities of every such parish shall be informed of the intention to insert such provision, and shall be entitled to be heard. The order may authorise the Board of Trade to extend any such period.

(2) A special advance under this section may be a free grant or a loan or partly a free grant and partly a loan.

(3) Any free grant or loan for a special advance under this section shall be made on such conditions and at such rate of interest as the Treasury direct.

6. Limitation on amount of advance and provision of money by National Debt Commissioners.—(1) The total amount advanced by the Treasury under this Act shall not at any one time exceed one million pounds, of which a sum not exceeding two hundred and fifty thousand pounds may be expended for the purpose of special advances under this Act.

(2) The National Debt Commissioners may lend to the Treasury, and the Treasury may borrow from the National Debt Commissioners, such money as may be required for the purpose of advances by the Treasury under this Act, on such terms as to interest, sinking fund, and period of repayment (not exceeding thirty years from the date of the loan) as may be agreed on between the National Debt Commissioners and the Treasury.

(3) The sums so lent by the National Debt Commissioners shall be repaid out of money provided by Parliament for the purpose, and if and so far as that money is insufficient shall be charged on, and payable out of, the Consolidated Fund, or the growing produce thereof.

7. Consideration of application by Light Railway Commissioners.—(1) Where an application for authorising a light railway under this Act is made to the Light Railway Commissioners, those Commissioners shall, in the first instance, satisfy themselves that all reasonable steps have been taken for consulting the local authorities, including road authorities, through whose areas the railway is intended to pass, and the owners and occupiers of the land it is proposed to take, and for giving public notice of the application, and shall also themselves, by local inquiry and such other means as they think necessary, possess themselves of all such information as they may consider material or useful for determining the expediency of granting the application.

(2) The applicants shall satisfy the Commissioners that they have

(*a*) published once at least in each of two consecutive weeks, in some newspaper circulating in the area or some part of the area through which the light railway is to pass, an advertisement describing shortly the land proposed to be taken and the purpose for which it is proposed to be taken, naming a place where a plan of the proposed works and the lands to be taken, and a book of reference to the plan, may be seen at all reasonable hours, and stating the quantity of land required; and

(*b*) served notice in the prescribed manner on every reputed owner, lessee, and occupier of any land intended to be taken, describing in each case the land intended to be taken, and inquiring whether the person so served assents to or dissents from the taking of his land, and requesting him to state any objections he may have to his land being taken.

The plan and book of reference shall be in the prescribed form, and for the purposes of this section the expression "prescribed" shall mean prescribed by rules made under this Act.

(3) The Commissioners shall, before deciding on an application, give full opportunity for any objections to the application to be laid before them, and shall consider all such objections, whether made formally or informally.

(4) If, after consideration, the Commissioners think that the application should be granted, they shall settle any draft order submitted to them by the applicants

for authorising the railway, and see that all such matters (including provisions for the safety of the public and particulars of the land proposed to be taken) are inserted therein, as they think necessary for the proper construction and working of the railway.

(5) The order of the Light Railway Commissioners shall be provisional only, and shall have no effect until confirmed by the Board of Trade in manner provided by this Act.

(6) Where an application for a light railway has been refused by the Light Railway Commissioners, the applicants, if the council of any county, borough, or district, may appeal against such refusal to the Board of Trade, who may, at any time, if they think fit, remit the application or any portion thereof to the said Commissioners, for further consideration, with or without special instructions.

8. **Submission of order to Board of Trade for confirmation.**—(1) The Commissioners shall submit any order made by them under this Act to the Board of Trade for confirmation, accompanied by such particulars and plans as may be required by the Board, and shall also make and lay before the Board, with the order, a report stating the objections which have been made to the application, and the manner in which they have been dealt with, and any other matters in reference to the order which the Commissioners may think fit to insert in the report.

(2) The Board of Trade shall give public notice of any order so submitted to them in such manner as they think best for giving information thereof to persons interested, and shall also state in the notice that any objections to the confirmation of the order must be lodged with the Board, and the date by which those objections must be lodged.

9. **Consideration of order by Board of Trade.**—(1) The Board of Trade shall consider any order submitted to them under this Act for confirmation with special reference to—

(*a*) the expediency of requiring the proposals to be submitted to Parliament; and

(*b*) the safety of the public; and

(*c*) any objection lodged with them in accordance with this Act.

(2) The Light Railway Commissioners shall, so far as they are able, give to the Board of Trade any information or assistance which may be required by the Board for the purpose of considering any order submitted to them or any objection thereto.

(3) If the Board of Trade, on such consideration, are of opinion that, by reason of the magnitude of the proposed undertaking, or of the effect thereof on the undertaking of any railway company existing at the time, or for any other special reason relating to the undertaking, the proposals of the promoters ought to be submitted to Parliament, they shall not confirm the order.

(4) The Board of Trade shall modify the provisions of the order for ensuring the safety of the public in such manner as they consider requisite or expedient.

(5) If any objection to the order is lodged with the Board of Trade and not withdrawn, the Board of Trade shall consider the objection, and give to those by whom it is made an opportunity of being heard, and if, after consideration, they decide that the objection should be upheld, the Board shall not confirm the order, or shall modify the order so as to remove the objection.

(6) The Board of Trade may, at any time, if they think fit, remit the order to the Light Railway Commissioners for further consideration, or may themselves hold or institute a local inquiry, and hear all parties interested.

10. **Confirmation of order by Board of Trade.**—The Board of Trade may confirm the order, with or without modifications, as the case may require, and an order so confirmed shall have effect as if enacted by Parliament, and shall be conclusive evidence that all the requirements of this Act in respect of proceedings required to be taken before the making of the order have been complied with.

11. **Provisions which may be made by the order.**—An order under this Act may contain provisions consistent with this Act for all or any of the following purposes—

(*a*) the incorporation, subject to such exceptions and variations as may be mentioned in the order, of all or any of the provisions of the Clauses Acts, as defined by this Act. Provided that, where it appears to the Board of Trade that variations of the Lands Clauses Acts are required by the special circumstances of the case, the Board of Trade shall make a special report to Parliament on the subject, and that nothing in this section shall authorise any variation of the provisions of the Lands Clauses Acts with respect to the purchase and taking of land otherwise than by agreement: and

(*b*) the application, if and so far as may be considered necessary, of any of the enactments mentioned in the Second Schedule to this Act (being enactments imposing obligations on railway companies with respect to the safety of the public and other matters); and

(*c*) giving the necessary powers for constructing and working the railway, including power to make agreements with railway and other companies for the purpose; and

(*d*) giving any railway company any power required for carrying the order into effect; and

(*e*) the constitution as a body corporate of a company for the purpose of carrying out the objects of the order; and

(*f*) the representation on the managing body of the railway of any council who advance, or agree to advance, any money for the purpose of the railway; and

(*g*) authorising a council to advance or borrow money for the purposes of the railway, and limiting the amount to be so advanced or borrowed, and regulating the terms on which any money is to be so advanced or borrowed; and

(*h*) the manner in which the profits are to be divided, where an advance is made by a council to a light railway company as part of the share capital of the company; and

(*i*) the proper audit of the accounts of the managing body of the railway where the managing body is not a local authority, and the time within which the railway must be constructed; and

(*j*) fixing the maximum rates and charges for traffic; and

(*k*) in the case of a new company, requiring the company to make a deposit, and providing for the time of making and the application of the deposit; and

(*l*) empowering any local authority to acquire the railway; and

(*m*) any other matters, whether similar to the above or not, which may be considered ancillary to the objects of the order or expedient for carrying those objects into effect.

12. Application of general Railway Acts.—(1) The Clauses Acts, as defined by this Act, and the enactments mentioned in the Second Schedule to this Act, shall not apply to a light railway authorised under this Act except so far as they are incorporated or applied by the order authorising the railway.

(2) Subject to the foregoing provisions of this Act, and to any special provisions contained in the order authorising the railway, the general enactments relating to railways shall apply to a light railway under this Act in like manner as they apply to any other railway; and for the purposes of those enactments, and of the Clauses Acts, so far as they are incorporated or applied by the order authorising the railway, the light railway company shall be deemed a railway company, and the order under this Act a special Act, and any provision thereof a special enactment. Provided that a light railway shall not be deemed to be a railway within the meaning of the Railway Passenger Duty Act, 1842 (5 & 6 Vict. cap. 79), and that no duties shall hereafter be levied in respect of passengers conveyed on a light railway constructed under this Act in respect of the conveyance of such passengers upon such railway.

13. Mode of settling purchase-money and compensation for taking of land.—(1) Where any order under this Act incorporates the Lands Clauses Acts, any matter which under those Acts may be determined by the verdict of a jury, by arbitration, or by two justices, shall, for the purposes of the order, be referred to and determined by a single arbitrator appointed by the parties, or if the parties do not concur in the appointment of a single arbitrator, then by the Board of Trade, and the provisions of this Act shall apply with respect to the determination of any such matter in lieu of those of the Lands Clauses Acts relating thereto. Provided that in determining the amount of compensation, the arbitrator shall have regard to the extent to which the remaining and contiguous lands and hereditaments belonging to the same proprietor may be benefited by the proposed light railway.

(2) The Board of Trade may, with the concurrence of the Lord Chancellor, make rules fixing a scale of costs to be applicable on any such arbitration, and may, by such rules, limit the cases in which the costs of counsel are to be allowed.

(3) The Arbitration Act, 1889 (52 & 53 Vict. c. 49), shall apply to any arbitration under this section.

14. Payment of purchase money or compensation.—Any order under this Act may, notwithstanding anything in the Lands Clauses Acts, authorise the payment to trustees of any purchase money or compensation not exceeding five hundred pounds.

15. Provisions as to Board of Trade (37 & 38 Vict. c. 40).—(1) If the Board of Trade hold a local inquiry for the purposes of this Act, Part I. of the Board of Trade Arbitrations, etc., Act, 1874, shall apply to any inquiry so held, as if—

(*a*) the inquiry was held on an application made in pursuance of a special Act; and

(*b*) the parties making the application for the order authorising the light railway, and in the case of an inquiry held with reference to an objection made to any such application the persons making the objection in addition, were parties to the application within the meaning of section 3 of the Act.

(2) The Board of Trade may make such rules as they think necessary for regulating the procedure under this Act, whether before the Board of Trade or before the Light Railway Commissioners, and any other matters which they may think expedient to regulate by rule for the purpose of carrying this Act into effect.

(3) There shall be charged, in respect of proceedings under this Act, before the Board of Trade or the Light Railway Commissioners, such fees as may be fixed by the Treasury on the recommendation of the Board of Trade.

(4) Any expenses of the Board of Trade under this Act shall, except so far as provision is made for their payment by or under this Act, be defrayed out of moneys provided by Parliament.

(5) The Board of Trade shall present to Parliament annually a report of their proceedings and of the proceedings of the Light Railway Commissioners under this Act.

16. Expenses of local authorities.—(1) The council of any county, borough, or district may pay any expenses incurred by them and allowed by the Light Railway Commissioners with reference to any application for an order authorising a light railway under this Act, in the case of a county council as general expenses, in the case of a borough council out of the borough fund or rate, and in the case of a district council other than a borough council as general expenses under the Public Health Acts.

Provided that any expenses incurred by a county council under this Act may be declared, by the order authorising the railway, or, in the event of an unsuccessful application for such an order, by the Light Railway Commissioners, to be exclusively chargeable on certain parishes only in the county, and those expenses shall be levied accordingly as expenses for a special county purpose under the Local Government Act, 1888 (51 & 52 Vict. c. 41).

(2) Where the council of any county, borough, or district are authorised to expend any money by an order authorising a light railway under this Act, they may raise the money required,—

(*a*) if the expenditure is capital expenditure, by borrowing in manner authorised by the order; and (*b*) if the expenditure is not capital expenditure, as if it was on account of the expenses of an application under this Act.

(3) The Board of Trade may, from time to time, on the application of any council, extend, subject to the limitations of this Act, the limit of the amount which the council are authorised by an order under this Act to borrow, or to advance to a light railway company, and the limit so extended shall be substituted for the limit fixed by the order.

(4) Where an order under this Act authorises any council to borrow for the purposes of a light railway, suitable provision shall be made in the order for requiring the replacement of the money borrowed within a fixed period not exceeding sixty years, either by means of a sinking fund or otherwise.

(5) Any profits made by a council in respect of a light railway shall be applied in aid of the rate out of which the expenses of the council in respect of the light railway are payable.

(6) Where a rate is levied for meeting any expenditure under this Act, the demand note for the rate shall state, in a form prescribed by the Local Government Board, the proportion of the rate levied for that expenditure.

17. Joint committees.—(1) The councils of any county, borough, or district may appoint a joint committee for the purpose of any application for an order authorising a light railway under this Act, or for the joint construction or working of a light railway, or for any other purpose in connection with such a railway for which it is convenient that those councils should combine.

(2) The provisions of the Local Government Act, 1888 (51 & 52 Vict. c. 41), or of the Local Government Act, 1894 (56 & 57 Vict. c. 73), as the case may be, with respect to joint committees, shall apply to any joint committee appointed for the purpose of this Act by any councils who could appoint a joint committee under those Acts, but where the councils have no power under those Acts to appoint a joint committee the provisions in the Third Schedule to this Act shall apply.

18. Working of ordinary railway as light railway.—Where a company have power to construct or work a railway, they may be authorised by an order under this Act to construct and work or to work the railway or any part of it as a light railway under this Act.

19. Power of owners to grant land or advance money for a light railway.—(1) Where any person has power, either by statute or otherwise, to sell and convey any land for the purpose of any works of a light railway, he may, with the sanction of the Board of Agriculture given under this section, convey the land for that purpose either without payment of any purchase money or compensation or at a price less than the real value, and may so convey it free from all incumbrances thereon.

(2) Whenever any person, who is a landowner within the meaning of the Improvement of Land Act, 1864 (27 & 28 Vict. c. 114), contributes any money for the purpose of any works of a light railway, the amount so contributed may, with the sanction of the Board of Agriculture given under this section, be charged on the land of the landowner improved by the works, in the same manner and with the like effect as in the case of a charge under that Act.

(3) The Board of Agriculture shall not give their sanction under this section unless they are satisfied that the works for which the land is conveyed or the money is contributed will effect a permanent increase in the value of the land held by the same title or of other land of the same landowner exceeding, in the case of a conveyance of land, that which is, in the opinion of the Board of Agriculture, the real value of the land conveyed or the difference between that value and the price, as the case may be, and in the case of a contribution of money the amount contributed: Provided also, that if the land proposed to be conveyed is subject to incumbrances, the Board of Agriculture, before giving their sanction under this section, shall cause notice to be given to the incumbrancers, and shall consider the objections, if any, raised by them.

20. Power to grant Crown lands.—The Commissioners of Woods shall, on behalf of Her Majesty, have the like powers to convey Crown lands as are by this Act conferred upon persons having power, either by statute or otherwise, to sell and convey lands, except that, in the case of Crown lands, the sanction of the Treasury shall be substituted for the sanction of the Board of Agriculture.

21. Provision as to commons.—(1) No land being part of any common, and no easement over or affecting any common, shall be purchased, taken, or acquired under this Act, without the consent of the Board of Agriculture, and the Board shall not give their consent unless they are satisfied that, regard being had to all the circumstances of the case, such purchase, taking, or acquisition is necessary, that the exercise of the powers conferred by the order authorising the railway will not cause any greater injury to the common than is necessary, and that all proper steps have been taken in the interest of the commoners and of the public to add other land to the common (where this can be done) in lieu of the land taken, and where a common is divided, to secure convenient access from one part of the common to the other.

(2) The expression "common" in this section shall include any land subject to be enclosed under the Inclosure Acts, 1845 to 1882, any metropolitan common within the meaning of the Metropolitan Commons Acts, 1866 to 1878, and any town or village green.

22. Preservation of scenery and objects of historical interest.—If any objection to any application for authorising a light railway is made to the Light Railway Commissioners, or if any objection to any draft order is made to the Board of Trade on the ground that the proposed undertaking will destroy or injure any building or other object of historical interest, or will injuriously affect any natural scenery, the Commissioners and the Board of Trade respectively shall consider any such objection, and give to those by whom it is made a proper opportunity of being heard in support of it.

23. Junctions with existing railways.—Any junction of a light railway authorised under this Act with any existing railway shall, so far as is in the opinion of the Board of Trade reasonably practicable, avoid the interference with lines of rails used for passenger traffic.

24. Amendment of order.—An order authorising a light railway under this Act may be altered or added to by an amending order made in like manner, and subject to the like provisions as the original order.

Provided that—

(*a*) the amending order may be made on the application of any authority or person; and

(*b*) the Board of Trade, in considering the expediency of requiring the proposals for amending the order to be submitted to Parliament, shall have regard to the scope and provisions of the original order; and

(*c*) the amending order shall not confer any power to acquire the railway except with the consent of the owners of the railway.

25. Provision as to telegraphs.—The definition of "Act of Parliament" in the Telegraph Act, 1878 (41 & 42 Vict. c. 76), shall include an order authorising a light railway under this Act.

26. Application to Scotland.—This Act shall apply to Scotland, with the following modifications:—

(1) In section 5 of this Act the expression "Secretary for Scotland" shall be substituted for the expressions "Board of Agriculture" and "Board of Trade" respectively, occurring in that section;

(2) References to the council of any county, borough, or district shall be construed as references to the county council of any county, or the town council, or where there is no town council the police commissioners, of any burgh, or the commissioners of any police burgh, or the district committee of any district under the Local Government (Scotland) Act, 1889 (52 & 53 Vict. c. 50); or in any county where there is no district committee any two or more parish councils may combine;

(3) "Arbiter" shall be substituted for "arbitrator," and that arbiter shall be deemed to be a single arbiter within the meaning of the Lands Clauses Acts,

and in lieu of the provisions of the Arbitration Act, 1889, the provisions of the Lands Clauses Acts with respect to an arbitration shall apply, except the provisions of the said Acts as to the expenses of the arbitration, in lieu of which the following provision shall have effect, namely, the expenses of the arbitration and incident thereto, shall be in the discretion of the arbiter, who may direct to and by whom, and in what manner those expenses, or any part thereof, shall be paid, and may tax or settle the amount of expenses to be so paid, or any part thereof, and may award expenses to be paid as between agent and client;

(4) The Lord President of the Court of Session shall be substituted for the Lord Chancellor;

(5) The money necessary to defray expenditure, not being capital expenditure, incurred by a county council in pursuance of this Act, shall be raised by a rate imposed along with but as a separate rate from the rate for maintenance of roads (hereinafter referred to as "the road rate") leviable under the Roads and Bridges (Scotland) Act, 1878 (41 & 42 Vict. c. 51), upon lands and heritages within the county, or the district, or the parish, as the case may be. The money necessary to defray expenditure similarly incurred by a town council, or police commissioners, or burgh commissioners shall be raised by a rate imposed along with but as a separate rate from the police assessment or burgh general assessment, as the case may be. If the expenditure incurred is capital expenditure it shall be raised by borrowing in the manner authorised by the order, the rate chargeable for repayment of capital, including interest and expenses, being the same rate as is liable for maintenance as aforesaid;

(6) The provisions relating to district councils shall apply to district committees or combinations of parish councils, subject to the following modifications—

(*a*) A district committee shall not be entitled to make an application under section two hereof except with the consent of the county council given at a special or statutory meeting of the council, of which one month's special notice, setting forth the purpose of the meeting, shall have been sent to each councillor,

(*b*) A resolution to give such consent shall not be passed by the council unless two-thirds of the councillors present and voting at the special or statutory meeting concur in the resolution,

(*c*) Nothing in this Act shall authorise a district committee to raise money by rate or loan, but any money necessary to defray expenditure, not being capital expenditure incurred by it in pursuance of this Act, shall be raised by the county council by a rate imposed along with but as a separate rate from the road rate; and any money necessary to defray capital expenditure shall be raised by the county council by borrowing in the manner authorised by the order, as in section sixteen hereof mentioned;

(7) The expression "Clauses Acts" shall mean the Lands Clauses Acts, the Railway Clauses Consolidation (Scotland) Act, 1845, the Companies Clauses Consolidation (Scotland) Act, 1845, the Companies Clauses Act, 1863, the Railways Clauses Act, 1863, and the Companies Clauses Act, 1869;

(8) References to the Local Government Act, 1888, and the Local Government Act, 1894, shall be construed as references to the Local Government (Scotland) Act, 1889 (52 & 53 Vict. c. 50), and the Local Government (Scotland) Act, 1894 (57 & 58 Vict. c. 58);

(9) In order to carry out in Scotland the provisions contained in sub-section (1) (*c*) of section five of this Act, it shall be the duty of the assessor of railways and canals, as regards any parish to which the said sub-section (1) (*c*) applies, to enter on his valuation roll either the annual value of the light railway within such parish ascertained in terms of the Valuation of Lands (Scotland) Acts, or the annual value at which the land occupied by or for the purposes of the light railway would have been assessed if it had remained in the condition in which it was immediately before it was acquired for the purposes of the railway, whichever is less;

(10) Where a light railway constructed under the powers of this Act is owned or leased by an existing railway company, such light railway shall not be valued by the said assessor as part of the general undertaking of the railway company, but shall be valued as a separate undertaking.

27. **Extent of Act.**—This Act shall not extend to Ireland.

28. **Definitions.**—In this Act, unless the context otherwise requires,—

The expression "light railway company" includes any person or body of persons, whether incorporated or not, who are authorised to construct, or are owners or lessees of, any light railway authorised by this Act, or who are working the same under any working agreement:

The expression "Clauses Acts" means the Lands Clauses Acts, the Railways Clauses Consolidation Act, 1845, and the Railways Clauses Act, 1863, and the Companies Clauses Acts, 1845 to 1889:

The expression "share capital" includes any capital, whether consisting of shares or of stock, which is not raised by means of borrowing.

29. **Short title.**—This Act may be cited as the Light Railways Act, 1896.

SCHEDULES.

FIRST SCHEDULE (SECTION 3).

MODE OF PASSING SPECIAL RESOLUTIONS.

1. The resolution approving of the intention to make the application must be passed at a meeting of the council.

2. The resolution shall not be passed unless a month's previous notice of the resolution has been given in manner in which notices of meetings of the council are usually given.

3. The resolution shall not be passed unless two-thirds of the members of the council present and voting concur in the resolution.

SECOND SCHEDULE (SECTION 12).

ENACTMENTS RELATING TO SAFETY, ETC.

Session and Chapter.	Title or Short Title.	Enactment referred to.
2 & 3 Vict. c. 45.	An Act to amend an Act of the fifth and sixth years of the reign of his late Majesty King William the Fourth relating to highways.	The whole Act.
5 & 6 Vict. c. 55.	The Railway Regulation Act, 1842.	Sections four, five, six, nine, ten.
9 & 10 Vict. c. 57.	An Act for regulating the gauge of railways.	The whole Act.
31 & 32 Vict. c. 119.	The Regulation of Railways Act, 1868.	Sections nineteen, twenty, twenty-two, twenty-seven, twenty-eight, and twenty-nine.
34 & 35 Vict. c. 78.	The Regulation of Railways Act, 1871.	Section five.
36 & 37 Vict. c. 76.	The Railway Regulation Act (Returns of signal arrangements, working, etc.), 1873.	Sections four and six.
41 & 42 Vict. c. 20.	The Railway Returns (Continuous Brakes) Act, 1878.	The whole Act.
46 & 47 Vict. c. 34.	The Cheap Trains Act, 1883.	Section three.
52 & 53 Vict. c. 57.	The Regulation of Railways Act, 1889.	The whole Act.

THIRD SCHEDULE (SECTION 17).

JOINT COMMITTEES.

(*a*) Any council taking part in the appointment of a joint committee may delegate to the committee any power which the council may exercise for the purpose for which the committee is appointed.

(*b*) A council shall not be authorised to delegate to a joint committee any power of making a rate or borrowing money.

(*c*) Subject to the terms of the delegation the joint committee shall have the same power in all respects with respect to any matter delegated to them, as the councils appointing it or any of them.

(*d*) The members of the joint committee may be appointed at such times and in such manner, and shall hold office for such period, as may be fixed by the councils appointing them:

Provided that a member shall not hold office beyond the expiration of fourteen days after the day for the ordinary election of councillors of the council by which he was appointed, or in Scotland after the day for the ordinary election of councillors of the council of the county in which the district is situated.

(*e*) The costs of a joint committee shall be defrayed by the councils by whom the committee is appointed, in such proportions as they may agree upon, and in the event of their differing in opinion, as may be determined by the Board of Trade on an application by either council.

(*f*) When any of the councils joining in the appointment of a joint committee is a county or district council other than a borough council, the accounts of the joint committee shall be audited in like manner and with the like power to the officer auditing the accounts, and with the like incidents and consequences as the accounts of a county council.

(*g*) The chairman at any meeting of the committee shall have a second or casting vote.

(*h*) The quorum, proceedings, and place of meeting of a committee, whether within or without the area within which the committee are to exercise their authority, shall be such as may be determined by regulations jointly made by the councils appointing the committee, and in the event of their differing in opinion as may be determined by the Board of Trade on an application by either council.

(*i*) Subject to those regulations the quorum, proceedings, and place of meeting, whether within or without the area within which the committee are to exercise their jurisdiction, shall be such as the committee direct.

APPENDIX IX.

STATUTORY RULES AND ORDERS, 1896.

No. 787.

RAILWAY.

Light Railway.

Rules dated September 1896, made by the Board of Trade with respect to Applications to the Light Railway Commissioners for orders authorising Light Railways.*

Notice of Proposed Application.

1. **Notice by advertisement.**—Notice of intention to apply to the Light Railway Commissioners for an order authorising a light railway, or for an amending order, must be published by advertisement in each of two consecutive weeks in the month of April or of October, in at least one local newspaper circulating in the area or part of the area through which it is proposed to make the railway.

2. **Contents of notice.**—The notice must describe generally the line of the railway and its termini, and the lands proposed to be taken, stating the quantity and the purpose for which it is proposed to take them; it must state the proposed gauge and motive power of the railway; it must be subscribed with the name of the person, company, or council responsible for the publication of the notice (hereinafter referred to as "the promoters"); and must name a place where a plan of the proposed works and of the lands to be taken and a book of reference to the plan and a section of the proposed works may be seen at all reasonable hours, and where copies of the draft order can be obtained on payment of not exceeding one shilling per copy.

The notice must state that objections should be made in writing to the Light Railway Commissioners in accordance with Rule 31.

3. **Deposit with local authorities.**—Copies of the draft order and of the plan and book of reference and section and of the estimate hereinafter mentioned, must be deposited by the promoters during the month of May or of November, with the clerk of the county council, and of every borough, district, and parish council in or through whose county, borough, district, or parish any part of the railway is proposed to be made; and shall be open to inspection during office hours.

With the above documents there must also be deposited a sheet or sheets of the ordnance map, on a scale of not less than one inch to a mile, with the line of railway indicated thereon, so as to show its general course and direction.

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* *Note.*—These Rules will regulate the procedure before the Light Railway Commissioners where a scheme for a light railway has been matured and it is intended to make a formal application for an order.

The Commissioners will at all times be prepared to give every facility in their power for considering and maturing proposals for the construction of light railways to be submitted to them.

4. **Deposits with Government Departments.**—Copies of the draft order and of all the above documents, must be deposited by the promoters during the month of May or of November, with the Board of Trade, and copies of the draft order with the Treasury, the Board of Agriculture, the Postmaster General, the Commissioners of Customs and of Inland Revenue, the Admiralty, the War Office, the Office of Woods and Forests, and the Office of Works, and with the Secretary for Scotland in the case of proposed railways in Scotland.

Provided that as regards the provisions of this Rule and of Rules 1 and 3, in the year 1896 the month of November shall be substituted for the month of October, and the month of December for the month of November.

Plans, Book of Reference, and Sections.

5. **Plans.**—Every plan must be drawn to a scale of not less than four inches to the mile, and must describe the lands intended to be taken, and the line or situation of the whole of the railway (no alternative line or work being in any case permitted), and the lands in or through which it is to be made, or through which any communication to or from the railway shall be made.

6. **As to limits of deviation.**—Where it is the intention of the promoters to apply for powers to make any lateral deviation from the line of the proposed railway, the limits of such deviation shall be defined on the plan, and all lands included within such limits shall be marked thereon.

7. **Buildings, etc., on enlarged scale.**—Unless the whole of such plan shall be upon a scale of not less than a quarter of an inch to every one hundred feet, an enlarged plan shall be added of any building, yard, courtyard, or land within the curtilage of any building, or of any ground cultivated as a garden, either in the line of the proposed work, or included within the limits of the said deviation, on a scale of not less than a quarter of an inch to every one hundred feet.

8. **Distances to be marked.**—The distances from one of the termini must be shown in miles and furlongs on the plan, and a memorandum of the radius of every curve not exceeding one mile in length shall be noted on the plan in furlongs and chains.

9. **Tunnelling to be marked.**—Where tunnelling as a substitute for open cutting is intended, the same shall be marked by a dotted line on the plan, and no work shall be shown as tunnelling in the making of which it will be necessary to cut through or remove the surface soil.

10. **Diversion of roads, etc.**—If it be intended to divert, widen, or narrow any public carriage road, navigable river, canal, or railway, the course of such diversion and the extent of such widening or narrowing shall be marked on the plan.

11. **Case of junctions with other lines.**—When a railway is intended to form a junction with an existing or authorised line of railway, the course of such existing or authorised line of railway shall be shown on the deposited plan for a distance of 800 yards on either side of the proposed junction on the same scale as the scale of the general plan.

12. **Case of rails along road.**—If it be intended to lay any part of the railway along a road or street, the plan shall show at what distance from an imaginary straight line drawn along the centre of such road or street it is proposed to lay the rails.

13. **Book of reference.**—The book of reference shall contain the names of the owners or reputed owners, lessees or reputed lessees, and occupiers of all lands and houses in the line of the proposed railway or within the limits of deviation as defined on the plan, and shall describe such lands and houses respectively.

The book of reference shall also contain the name of the road authority of any road or street along which it is proposed to lay any part of the railway.

14. **Scale of sections.**—The section shall be drawn to the same horizontal scale as the plan, and to a vertical scale of not less than one inch to every one hundred feet, and shall show the surface of the ground marked on the plan, the

intended level of the proposed railway, the height of every embankment and the depth of every cutting, and a datum horizontal line, which shall be the same throughout the whole length of the railway or any branch thereof respectively, and shall be referred to some fixed point (stated in writing on the section), near one of the termini of the railway.

In every section the line of the railway marked thereon shall correspond with the upper surface of the rails.

15. **Vertical measures to be marked at change of gradient.**—Distances on the datum line shall be marked in miles and furlongs, to correspond with those on the plan; a vertical measure from the datum line to the line of the railway shall be marked in feet and inches, or decimal parts of a foot, at the commencement and termination of the railway, and at each change of the gradient or inclination thereof; and the proportion or rate of inclination between every two consecutive vertical measures shall also be marked.

16. **Height of railway over or depth under surface of roads, etc., to be marked.**—Wherever the line of the railway is intended to cross any public carriage road, navigable river, canal, or railway, the height of the railway over or depth under the surface thereof, and the height and span of every arch of all bridges and viaducts by which the railway will be carried over the same, shall be marked in figures at every crossing thereof, and where the railway will be carried across any such public carriage road or railway, on the level thereof, such crossing shall be so described on the section, and it shall also be stated if such level will be unaltered.

17. **Cross sections in certain cases.**—If any alteration be intended in the water level of any canal, or in the level or rate of inclination of any public carriage road or railway, which will be crossed by the railway, then the same shall be stated on the section, and each alteration shall be numbered; and cross sections in reference to the numbers, on a horizontal scale of not less than one inch to every three hundred and thirty feet, and on a vertical scale of not less than one inch to every forty feet shall be added which shall show the present surface of such road, canal, or railway, and the intended surface thereof, when altered; and the greatest of the present and intended rates of inclination of the portion of such road or railway intended to be altered shall also be marked in figures thereon, and where any public carriage road is crossed on the level, a cross section of such road shall also be added; and all such cross sections shall extend for two hundred yards on each side of the centre line of the railway.

18. **Embankments and cuttings.**—Wherever the extreme height of an embankment, or the extreme depth of any cutting, shall exceed five feet, the extreme height over or depth under the surface of the ground shall be marked in figures on the section; and if any bridge or viaduct of more than three arches shall intervene in any embankment, or if any tunnel shall intervene in any cutting, the extreme height or depth shall be marked in figures on each of the parts into which such embankment or cutting shall be divided by such bridge, viaduct, or tunnel.

19. **Tunnelling and viaduct to be marked.**—Where tunnelling, as a substitute for open cutting, or a viaduct as a substitute for solid embankment, is intended, the same shall be marked on the section, and no work shall be shown as tunnelling, in the making of which it will be necessary to cut through or remove the surface soil.

20. **In case of junctions gradient of existing line to be shown on section.**—When a railway is intended to form a junction with an existing or authorised line of railway, the gradient of such existing or authorised line of railway shall be shown on the deposited section, and in connection therewith, and on the same scale as the general section, for a distance of 800 yards on either side of the point of junction.

Notices to Owners, Lessees, and Others.

21. **Service of notices on landlords and others.**—During the month of April or of October the promoters must serve a notice on the owners, or reputed

owners, lessees, or reputed lessees, and occupiers of all lands intended to be taken or being within the limits of deviation shown on the deposited plan, describing in each case the particular lands intended to be taken or being within such limits, and inquiring whether the person so served assents or dissents to the taking of such lands, and requesting him to state any objections he may have to such lands being taken.

Every such notice shall be as nearly as may be in the form set out in the schedule to these Rules.

22. **Notice to owners of railway, etc.**—During the month of April or October the promoters must also serve a notice of the intended application on the owner, or reputed owner, lessee, or reputed lessee, of any railway, tramway, or canal which will be crossed or otherwise interfered with by the proposed railway; and on the road authority (where other than a county, borough, district, or parish council) of any road or street along which it is proposed to lay any rails, or which will be otherwise interfered with by the proposed railway; and such notice shall state the place or places where a plan or plans of the proposed railway has or have been or will be deposited.

Provided that as regards the provisions of this Rule and of Rule 21, in the year 1896 the month of November shall be substituted for the month of October.

23. **Notice of relinquishment of works.**—Where an amending order proposes to authorise the promoters to vary or to relinquish the whole or any part of a railway authorised by a former order, the promoters must during the month of April or October serve notice of the proposal on the owners, or reputed owners, lessees, or reputed lessees, and occupiers of the lands in which any part of the said railway is situate.

24. **Notice of repeal of protective provisions.**—Where an amending order proposes to repeal or alter any provision contained in a former order for the protection or benefit of any person, public body, or company specifically named, the promoters must during the month of April or October serve notice of the intention to repeal or alter such provision on every such person, public body, or company.

Estimate.

25. **Estimates.**—An estimate of the expenses of the proposed railway (including the expense of acquiring land and all incidental expenses) must be made and signed by the person making the same.

26. The estimate shall be in the following form, or as near thereto as circumstances may permit:—

Estimate of the proposed Light Railway.

			Whether Single or Double.	
Lines No.				
Length of line . . .	miles fgs.	chs.		
Gauge				
	Cubic Yards.	Price per Yard.	£ s. d.	£ s. d.
Earth-works:				
Cuttings—Rock . .				
Soft soil . .				
Roads . .				
Total . .				
Embankments, including roads . .		Cubic yards		
Bridges—Public roads . . .		Number		
Accommodation bridges and works				
Viaducts				
Culverts and drains				
Metallings of roads and level-crossings				
Gatekeepers' houses at level-crossings				
Permanent-way, including fencing:			Cost per mile.	
miles fgs. chs.			£ s. d.	
at				
Permanent-way for sidings, and cost of junctions . . .				
Stations				
Contingencies . . . . Per cent. . .				
Land and buildings:				
a. r. p.				
Total . . £				

The same details for each branch, and general summary of total cost.

Application to the Commissioners.

27. Documents to accompany application.—Every application to the Commissioners for an Order must be made in the month of May or of November except in the year 1896, when it must be made in the month of December, and must be in the case of a corporate body under the seal of such body, and in any other case signed by the promoter or promoters, or if there are more than two, then by any three of them, and must be accompanied by—

(*a*) a copy of the advertisement of the intention to apply for the order;

(*b*) three copies of the draft order and of each of the documents required by these Rules to be deposited;

(*c*) a statement as to the proposed gauge and motive power of the railway;

(*d*) a list of the owners, or reputed owners, lessees, or reputed lessees, and occupiers on whom notices have been served, and a statement as far as can then be made whether in each case they assent, dissent, or are neuter;

(*e*) a list of the county borough district and parish councils in or through any part of whose county district or parish any part of the railway is proposed to be made, and a statement whether or not they have intimated assent or dissent to the proposal;

(*f*) a list of the railway, tramway, or canal companies (if any) on whom any notice has been served under these Rules, and a statement whether or not they have intimated assent or dissent to the proposal;

(*g*) a statement whether any consent of the Board of Agriculture required to any grant of land or to the acquisition of any common land proposed to be authorised by the draft order has been obtained;

(*h*) a statement whether it is proposed that the Council of any county borough or district shall expend or advance any money, and if so, of the nature and amount of such expenditure or advance;

(*i*) a statement whether it is proposed to apply to the Treasury for the advance of any money, and if so, of the amount of the advance sought;

(*k*) a certificate that a fee of £50 has been paid to the Board of Trade;

(*l*) a certificate in the case of an application by an existing company, that the members of the company have assented to the application by such a resolution as is required by the Standing Orders of Parliament in the case of an application to Parliament by such company.

General Provisions as to Notices.

28. **Authentication, etc., of notices.**—Notices and other such documents under these Rules may be in writing or print, or partly in writing and partly in print; and shall be sufficiently authenticated if signed by the clerk of the council, or by some principal officer of the company, or by the promoter or any two or more of the promoters, on whose behalf the notice or other document is served.

29. **Service of notices.**—Notices and any other documents required or authorised to be served under these Rules may be served by delivering the same to or at the residence of the person to whom they are respectively addressed, or where addressed to the owner or occupier of premises by delivering the same or a true copy thereof to some person on the premises; or if there is no person on the premises who can be so served, then by fixing the same on some conspicuous part of the premises; they may also be served by post by a prepaid letter, and if served by post shall be deemed to have been served at the time when the letter containing the same would be delivered in the ordinary course of post, and in proving such service it shall be sufficient to prove that the notice or other document was properly addressed and put into the post.

Any notice by these Rules required to be given to the owner or occupier of any premises may be addressed by the description of the "owner" or "occupier" of the premises (naming them) in respect of which the notice is given without further name or description.

Fees.

30. **Fee payable to Board of Trade.**—Before lodging any application with the Commissioners a fee of £50 must be paid by the promoters to the Board of Trade, by cheque in favour of an Assistant Secretary of the Board of Trade.

General.

31. All communications to the Commissioners should be on foolscap paper and written on one side only, and should be addressed to—

The Secretary,
Light Railway Commission,
23 Great George Street,
London, S.W.

32. In the case of an application for an amending order, such of the requirements of these Rules as are inapplicable will be dispensed with.

33. These Rules shall remain in force until modified by the Board of Trade.

The Board of Trade,
September 1896.

COURTENAY BOYLE,
Secretary.

SCHEDULE.

Form of Notice to Landowners and others.

SIR,

WE beg to inform you that application is intended to be made to the Light Railway Commissioners for an order authorising a light railway from to , and that the property mentioned in the annexed schedule or some part thereof, in which we understand you are interested as therein stated, will be required for the purposes of the said railway, according to the line thereof as at present laid out, or may be required to be taken under the usual powers of deviation to the extent of yards on either side of the said line which will be applied for.

We also beg to inform you that a plan and section of the said undertaking, with a book of reference thereto, have been or will be deposited with the clerks of the (*specify county and other councils as the case may be*) on or before the last day of May [*or* November], and that copies of so much of the said plan and section as relates to the (*parish*) in which your property is situate, with a book of reference thereto, have been or will be deposited for public inspection with the (*clerk of the parish, district, or borough council*) on or before the day of on which plan your property is designated by the numbers set forth in the annexed schedule.

As we are required to report whether you assent to or dissent from the proposed undertaking, you will oblige us by writing your answer of assent or dissent in the form left herewith, and by stating any objections you may have to your property being taken, and returning the same to us with your signature on or before the day of next; and if there should be any error or misdescription in the annexed schedule, we shall feel obliged by your informing us thereof at your earliest convenience, that we may correct the same without delay.

We are, &c.,

Schedule referred to in the foregoing notice describing the property therein alluded to :—

	Parish, Township, Townland, or extra-parochial Place.	Number on Plans.	Description.	Owner.	Lessee.	Occupier.
Property on the line of the proposed work, or within the limits of the deviation intended to be applied for.						

I, the undersigned, assent to [dissent from] my property being taken for the proposed work [and my objections are that].

APPENDIX X.

GENERAL ENACTMENTS RELATING TO RAILWAYS REFERRED TO IN SECTION 12 (2) OF THE LIGHT RAILWAYS ACT, 1896, AND NOT PREVIOUSLY NAMED IN CHAP. XI.

Carriers Protection Act, 1830 (1 Will. IV. c. 68).

[This Statute (11 Geo. IV. & 1 Will. IV. c. 68) protects "common carriers for "hire, against the loss of or injury to parcels or packages delivered to them for "conveyance or custody, the value and contents of which shall not be declared "to them by the owners thereof." Under this Act a common carrier is not liable for loss or injury to money, gold, silver, jewellery, banknotes, stamps, title-deeds, securities, paintings, glass, china, silks, etc., when the value exceeds £10, unless it shall have been declared at the time of delivery, and the increased charge accepted by the person receiving such parcel or package. But common carriers cannot limit their liability at common law in respect of other goods not covered by this Act. Nor does this Statute protect the carrier from any loss arising from the felonious act of any servant in his employ; nor from responsibility to the owner for loss occasioned by delay, over-sending or mis-sending them, or, generally, in any case where the damage complained of is occasioned by the carrier's misfeasance. See Chitty's *Law of Contracts*, Ch. III., edit. 1876.]

Conveyance of Mails by Railways, 1837 (1 & 2 Vict. c. 98).

Regulation of Railways Act, 1840 (3 & 4 Vict. c. 97).

[This Statute deals with returns to be made by the company, bye-laws, branch railways, etc.]

Regulation of Railways Act, 1844 (7 & 8 Vict. c. 85).

[Tolls, Board of Trade prosecutions, cheap trains, etc.]

Documentary Evidence, 1845 (8 & 9 Vict. c. 113).

Railway Clearing System, 1850 (13 & 14 Vict. c. 33).

Abandonment and Dissolution of Railways, 1850 (13 & 14 Vict. c. 83).

Railway and Canal Traffic, 1854 (17 & 18 Vict. c. 31).

[Traffic facilities, undue preference, through traffic, special contract as to goods and animals.]

Railway Companies Arbitration Act, 1859 (22 & 23 Vict. c. 59).

Lands Clauses Consolidation Act (Amendment), 1860 (23 & 24 Vict. c. 106).

Railway Companies Powers, 1864 (27 & 28 Vict. c. 120).

Railway Companies Securities Act, 1866 (29 & 30 Vict. c. 108).

[Loan capital account to be kept open to inspection, etc.]

Lands Clauses Consolidation Act (Amendment), 1869 (32 & 33 Vict. c. 18).

Abandonment of Railways, 1869 (32 & 33 Vict. c. 114).

Railways (Powers and Construction) Amendment Act, 1870 (33 & 34 Vict. c. 19).

Railway Rolling-Stock Protection Act, 1872 (35 & 36 Vict. c. 50).

Railway and Canal Traffic, 1873 (36 & 37 Vict. c. 48).

Contagious Diseases (Animals), 1878 (41 & 42 Vict. c. 74).

Commonable Rights (Compensation), 1882 (45 Vict. c. 15).

Post Office (Parcels), 1882 (45 & 46 Vict. c. 74).

Railway and Canal Traffic, 1888 (51 & 52 Vict. c. 25).

SUPPLEMENTARY NOTE ON THE COLONIES.

THERE are generally so few obstacles in the way of cheap construction and simple methods of working in the Colonies, wherever the utmost economy is essential, that light railways are frequently built without being specially classed as such. Thus, the office (in London) of the Agent-General for Western Australia would probably inform an enquirer that the government of that colony have not adopted the system of light railways; and, indeed, a country which has constructed 830 miles of 3 feet 6 inch gauge railway at a cost of not more than £4499 per mile may very well do without a separate system of still cheaper lines. Data regarding light railway development in South Australia may not be directly obtainable from the London office, and the cost per mile of railway on both gauges (5 feet 3 inches and 3 feet 6 inches) may average as much as £7364, but extensions on the broader gauge were actually made on light railway principles more than thirty years ago. The cost per mile of railways in Queensland is less, but the government of that colony last year deputed their chief engineer to visit and report on light railways in Europe and America. The average cost of railways in Victoria is about £12,250 per mile, and a trial of light railways is being made in one or two of the outlying districts. The Mallee extensions in Victoria may not individually show a profit, but they act as feeders to main lines, they contribute to the general revenue, they have encouraged the settlement and the cultivation of an increased area, the traffic is growing, and their practical success is assured. The cost of railways in New South Wales is as much as £14,157 per mile, but lines of the "Pioneer" class are now being laid in that colony at a cost of only £2019 per mile. In Natal 402 miles of railway on the 3 feet 6 inch gauge have cost as much as £15,514 per mile. The cost per mile of 2253 miles of railway, on the same gauge, in Cape Colony is (quoted by the Minister of Railways, New Zealand, 1898, Return No. 15, at) £9407. The cost per mile of 2055 miles of railway in New Zealand —also on the 3 feet 6 inch gauge—is £7783, according to the latest figures; in this colony there appear to be no light railways, specially so-called, other than tramways.

In Canada, during the warmer season of the year from April to

November, waterway communication is open for 2260 miles from the mouth of the St Lawrence to Port Arthur. Thence to the Pacific railway communication covers an almost equal mileage. In the winter months the whole distance must be traversed by railway. The paid-up capital on 15,768 miles of completed railway is \$887,975,020, or £11,263 per mile. The confederation of Canada was accomplished in 1867. The construction of the Canadian Pacific Railway was commenced in 1877. The Dominion adopted in 1882 a policy of assisting companies by grants of money and lands under rigid restrictions in regard to quality of work. In the East, cash subsidies per mile of \$1600, \$3200, or even \$6400 were granted under the Railway Subsidy Acts. In the West, the subsidies took the form of land grants, and used rails were also given. In 1886 the Canadian Pacific Railway was completed. Up to the end of June 1894 the Dominion Government had assisted the construction of other than its own lines to the extent of £2,250,000, the Provincial Governments had contributed nearly £6,000,000, and municipalities nearly £3,200,000. The railways referred to on page 109 as examples of cheap construction on a narrow gauge have long since been incorporated in the Grand Trunk Railway and the whole of the Canadian railway system is now laid on the 4 feet 8½ inch gauge.

SUPPLEMENTARY NOTE ON THE PROMOTION AND WORKING OF LIGHT RAILWAYS.

(Sectional Discussions and Conclusions relating to Light Railways reported in the *International Railway Congress Bulletin*, vol. ii. 1897.)

Contributive Traffic (M. de Bäcker's paper).—Feeder lines serve local, public and national interests so largely that they should be assisted, if necessary, by corporate bodies. This assistance should, preferably, take the form of subscriptions for ordinary shares. The great companies should not supply capital to the feeder lines, but should pay them a bonus per passenger or per ton. Through booking of goods is not advised, not only because the expense of through service falls mainly on the small line, but also because the latter is forced to adopt the rates, classification, regulations, and system of accounts which obtain on the big line. The small line requires little or no classification, and should be able to apply its own rates (pp. 822–837).

Relaxation of Normal Requirements for Light Railways.—Governments are generally recommended to facilitate the construction and working of light railways, which, however, must not be allowed to compete unfairly with existing lines. Similar facilities should be granted to lines of light traffic which form part of main-line systems (pp. 840–880).

Working of Light Railways by Leasing Companies.—As a rule, the lessee should provide the rolling-stock, and the terms upon which the rolling-stock is to be taken over on the expiry of the lease require very careful consideration. There would be less objection to a subsidy based on the repayment of actual expenses, if the lessee profited by increasing the net receipts, as, *e.g.*, if he were awarded *premia* for economies effected on a maximum cost of working. The payment of subsidies based on train-mileage is not recommended. It would be more satisfactory to allot to the lessee a percentage of the gross receipts, with or without a fixed sum in addition, whether or not the same coefficient be applied to passenger as to goods receipts, and whether or not there be a special remuneration based on passenger-mileage, ton-mileage, or train-mileage (pp. 1031–1079).

Light Railway Shops.—No general rule could be laid down regarding the best position for workshops and running-sheds. The merits of one site or another must be considered with reference to the special conditions of each case (pp. 1186–1197).

Brakes for Light Railways.—Here, again, it must be recognised that the conditions are too variable to allow of definite conditions being formulated as to the special brakes to be used on light railways. It is obvious, however, that economy must be the first consideration (pp. 1200–1221).

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